American
FORESTS
The Magazine of Forests, Soil, Water, Wildlife, and Outdoor Recreation
JULY 1960 50 CENTS

Pests, Pesticides, and People

SEE PAGE 39

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American
FORESTS

PUBLISHED BY THE AMERICAN FORESTRY ASSOCIATION

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James B. Craig
EDITOR

Betty Kindleberger
ASSISTANT EDITOR

James J. Fisher
ART DIRECTOR

Vol. 66, No. 7, July, 1960

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THE COVER

The serene beauty of Moraine Lake in the Canadian Rockies makes a perfect vacation picture.

PHOTOGRAPH BY EASTMAN KODAK

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Forest Forum

Silver Anniversary

EDITOR:

I want to thank you for the splendid job you did with the "Silver Anniversary of the SCS." I like it so well I wish, if you could spare them, that you could send copies of the magazine to all of my friends.

Hugh H. Bennett
5411 Kirby Road
Falls Church, Virginia

(That would be a big order, Chief—Editor)

The Fischer Article

EDITOR:

Congratulations on the most excellent June issue of AMERICAN FORESTS!

I admire your courage in publishing "Conservation: What Definition Do You Use?" by Virlis L. Fischer. You will undoubtedly be attacked by the "Preservationists," whose ruthless tactics Mr. Fischer so correctly describes.

What Mr. Fischer did not describe is the undemocratic makeup of most of these preservationist (not conservation) organizations. Their policies and methods are determined solely by their paid officers, who later tell their self-perpetuating boards of directors what they have done. Their members have no voice in selecting officers and determining their actions. They are expected only to pay their dues and to write letters to their Congressmen along the lines dictated by their officers.

This is in contrast to The American Forestry Association, whose policies are determined by an elected Board of Directors, and to the Chamber of Commerce of the United States, whose entire membership votes on its policy directives after approval by its elected Board and its Policy Committee.

Congratulations also on the diagnosis of "The Case of: Limited Land, Unlimited Demand" by "Doctor" H. R. Glascock, Jr. He has shown that what we need is unbiased diagnosis and sane treatment, not hysterical measures. . .

Richard W. Smith
Manager
Natural Resources Department
Chamber of Commerce
of the United States

EDITOR:

As a longtime reader and quondam contributor to your magazine I am amazed that you would publish the rabble-rousing speech of Virlis Fischer in your June issue. It is full of the vaguest generalities, non sequiturs, blithe ifinuendos, and egotistical maunderings.

To enlighten your readers, you should tell them that Mr. Fischer does not speak for the Sierra Club (of which he is a disgruntled member), nor for the Mazamas (he now lives in Las Vegas and is no longer active in that group), nor for anybody but himself.

Once upon a time AMERICAN FORESTS was an objective and scholarly-type general circulation magazine, dedicated to enlightenment of its readers. Let's hope it gets back on the track very soon, and ceases to be an outlet for disgruntled vocal persons of various persuasions.

Anthony Netboy
2344 S. W. Mitchell Street
Portland 19, Oregon

Honaunau Forest

MR. NORMAN K. CARLSON:

I want you to know that I recently received the biggest surprise I have experienced thus far this year when I got around to taking a good look at the April issue of AMERICAN FORESTS and found your most interesting and exceedingly well written article on the Honaunau Forest. It gave me a stimulating desire to retake the excellent show-me trip that you gave me of your forest. It brought back many intriguing recollections of an experience long to be remembered.

The editor of AMERICAN FORESTS is also to be congratulated on his good judgment in accepting an article so well written on a very timely subject.

C. F. Korstian
Professor Emeritus
Of Silviculture
Duke University
Durham, N. C.

(Mr. Carlson is now busy working on another Hawaiian forestry article for *American Forests*—Editor).

From Dust Bowl to Grass

Nearly four million acres of public lands mostly in the Great Plains states, have been renamed national grasslands by the Department of Agriculture and placed under the permanent jurisdiction of the Forest Service. The step is regarded as a move to nail down the continuing effort to promote the economic stability of Great Plains agriculture. When these lands became dust bowls they were taken over by the federal government during the depression, and were managed by the Soil Conservation Service from 1938 through 1953. Under the Forest Service they will be managed under multiple use and sustained yield management plans with the emphasis on grass production. States in which the lands are situated include North and South Dakota, Colorado, Kansas, Nebraska, Wyoming, Oklahoma, New Mexico, Idaho and Oregon.

Pipeline

EDITOR:

We have been subscribers to the association since 1952 and have read with interest your magazine AMERICAN FORESTS. Now we have a forestry problem of our own and would like to seek your advice.

It seems that the ever-increasing water shortage has reached Baltimore, Md., and made it necessary for them to plan a 9 pipeline from the Susquehanna River to their reservoirs. This pipeline will run through our property, crossing our fast-running Elbow Branch three times and making a diagonal cut 110' wide through our 45-acre tract of woods, a great deal of which is on steep land.

I won't go into the heartbreaking details, as I know the people in your office understand the difference between a beautiful stand of tulip poplar interspersed with many flowering dogwood, laurel, redbud, and spice bush with a ground cover of wild flowers and native ferns, and a wide strip of bare ground which has been thoroughly packed by extremely heavy equipment. But I would like to ask you what, in your opinion, would be the best possible safeguard against erosion and the possible undermining of trees on the top side of the cut in a situation like this? Sixty of the 110 feet will be permanent right-of-way, the 50 feet of construction right-of-way is divided (not always evenly) on the outside edges.

With pipelines, roads and housing developments increasing in number every day, it is becoming more and more difficult to preserve any natural forests, so any suggestions you can make will be gratefully received.

Mrs. William B. Reese
Seven Spring Farm
Havre De Grace, Maryland

(Try wild honeysuckle—Editor)

Stamp Album

EDITOR:

Upon my return from leave, I received a delightful surprise. I am the fellow Mr. Mitchell had in mind when he asked about commemorative stamps on the occasion of the Seventh National Watershed Congress. I had hoped that I might get a block of four, but to receive a sheet of stamps autographed by the Postmaster General himself —and in its own distinctive, beautifully embossed folder! I have never had the privilege of owning such a gem, and I am truly indebted to you for your unusual thoughtfulness. Many, many thanks!

If I can ever be of assistance to you or to The American Forestry Association, I am at your service.

Marcel A. Coviello
Senior Chief Musician, U.S. Navy
Assistant for Administration
U.S. Navy Band

Interior Secretary Fred A. Seaton

SEATON HONORED

Secretary of the Interior Fred A. Seaton was cited on June 20 by many of the nation's foremost conservation groups and membership associations for "distinguished and courageous service rendered in the conservation and management of the country's natural resources."

Seaton, the principal speaker at the annual banquet of the Western Association of State Game and Fish Commissioners, was given a "Distinguished Conservation Service Award" in a surprise ceremony by 15 major organizations representing official agencies, societies, and millions of outdoor enthusiasts and conservationists.

A spokesman for the groups said that this is the first time they have jointly honored a cabinet member for conservation achievement and service. He said they were pleased to be able to honor Seaton in the West where much of the public lands are located.

Citing Seaton were the Western Association of State Game and Fish Commissioners, International Association of Game, Fish and Conservation Commissioners, Boone and Crockett Club, Izaak Walton League of America, National Audubon Society, National Parks Association, National Rifle Association of America, National Wildlife Federation, Natural Resources Council of America, North American Wildlife Foundation, Sierra Club, Sport Fishing Institute, The American Forestry Association, Wilderness Society, and the Wildlife Management Institute.

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Reading about RESOURCES

By MONROE BUSH

A MYSTERIOUS LAND

THERE is too often a tendency among resource specialists to over-concentrate upon those wealth-giving resources which are presently in great demand, to the virtual exclusion of a broad view that sees the earth's inherent natural wealth as a single life-sustaining resource of infinite variety and diversity.

Without such a broad view it is not only difficult to understand the relationships that exist between specific resource substances, but also to comprehend the nature of the yet untapped wealth upon which the future must increasingly depend.

I believe that every specialist must be, therefore, something of a geographer as well. His knowledge in depth will be inefficiently myopic unless he possesses also a significant knowledge in breadth. Consequently, and inescapably, some of the most important resource literature being published today is essentially geographical—for only as he perceives the sweeping unity in diversity of world resources can he as an intellectually specialized person become also a competent leader of the first order.

Last month I reviewed Marston Bates' major book, **The Forest and the Sea;** this month there is at hand a smaller, far less important, volume by Friedrich Morton entitled **In the Land of the Quetzal Feather** (Devin-Adair, 1960. 208 pp. $4.50). Both works deal with the tropical biota. Bates draws much information from Colombia; Morton writes a rambling travelogue of back-country Guatemala. Both lands lie in the New World, both are hot, both have widely varying terrain, both have been civilized under Spanish influence. At first glance it might appear that the reading of only one of these books would be necessary—and the reading of **The Forest and the Sea** is certainly necessary. Yet the data they provide is so strikingly dissimilar that, insofar as this particular section of the world is concerned, neither could be conceived as taking the place of the other.

Of the two, Bates' work is the more ambitious, the more scholarly, the more far-ranging, and hence the first to buy. Yet the resource picture which Morton gives in his casual, back-handed sort of way gives strong, almost poetic impressions of the character of the land and its wildlife that are important. There is no effort here at orderly exposition. He does not write as a scientist, or, for that matter, as a literary person. The text is simple, clear and episodic. Despite all the superlatives that the fine Bates book deserves, the exciting, dramatic narratives in **In the Land of the Quetzal Feather** leave the reader with a vivid sense of the terrible tensions and conflict that exist in the Central American biota—and in this manner the two books are comparable.

From his first paragraph, Morton makes it clear that he is writing of a world different from anything the untraveled North American might know. There is great wealth here, but no one has yet evolved resource-equations for its sensible utilization—that is invariably the challenge of far-away, undeveloped places.

He begins: "The seemingly endless Guatemalan *potrero,* the pasture land, has a certain grandeur, but it is both monotonous and dangerous. There are no luscious meadows, rushing springs or willow trees, and, when the rainy season is over, the soil becomes dry and hard, the grass sparse and brittle. There is no pleasure in wandering through the *potrero.* The sharp hooks of the mimosa undergrowth tear pieces out of one's shirt and rip the skin; abundant weeds, growing as high as six feet, engulf horse and rider and shower on them *garapatos* or ticks which can cause a high fever. One dare not walk, even for a short distance, because the light is so blinding and the heat so intense that the senses become dulled; this can be fatal, for the *potrero* is the home of the rattlesnake."

From that introduction we are carried swiftly, almost as if we were listening to the yarns of an old adventurer, through all aspects of Guatemalan countryside, rich and luxurious in a distinctly different way than we may ever have conceived those words before.

His descriptions of the snakes, the insects, the agricultural plants and the jungle, all give a broadening, educational impression which the reader is sure to carry with him for a long time indeed—and such an impression may well be more useful than the data one reads and as quickly forgets in a dozen learned documents.

New and To Note

Home gardening being what it is—and that depends entirely on whom you ask—the summer is a time for the study of the problem-solving literature of keeping up with the Joneses' yard.

Two helpful books have appeared recently: **Budget Landscaping** by Carlton B. Lees (Henry Holt, 1960. 152 pp. $3.95); and **Diseases and Pests of Ornamental Plants,** 3rd Edition, by Pascal P. Pirone, Bernard O. Dodge, and Harold W. Rickett (Ronald Press, 1960. 775 pp. $10.00).

The first is for the amateur who either needs economical, attractive planting for a barren yard, or a new

(*Turn to page* 87)

FORESTER'S NOTEBOOK

THE American Forestry Association's study of the ownership, use, and management of forested land in North Carolina moved into full stride on June 1 as staff members began a two per cent sampling of all landowners in the state. About 5,000 to 6,000 ownerships will be reviewed. Suburban residential districts and rural tracts less than three acres in size will not be considered.

Members of the North Carolina Department of Forestry are assisting AFA personnel in determining the gross acreage of each ownership and the net area in forest, the occupation of each owner, and the acreages held by farmers, housewives, business men, professional people, and other classes of owners.

Upon completion of the above tabulation, a sub-sample of the woodland owners, probably between 10 and 20 per cent of the base list, will be taken at random throughout the state for personal interviews by Dr. James G. Yoho, forest economist at Duke University. Dr. Yoho will endeavor to determine and evaluate each woodland owner's actual forestry achievement, comprehension of forestry, attitude toward public forestry issues as well as toward his or her own woodland problems, means of acquiring an understanding of forestry, and plans for the future management of the woodland.

These questions are of much interest to forest industries as well as to public agencies because there are relatively few large forest ownerships in North Carolina. Consequently furniture companies, lumbermen, and pulpwood users must acquire most of their raw materials from small private holdings. Yet many city dwellers are buying picturesque tracts along lakes and streams for purposes other than timber production.

What impact will this trend have upon future wood procurement policies?

This question and many related ones were asked by 25 professional foresters while attending a meeting of AFA's Advisory Committee in Raleigh on May 24. The pulpwood industry indicated special interest in the project.

Concurrently with Dr. Yoho's interviews, Mr. William P. Thompson, a doctoral candidate at Duke University, is making an analysis of the economic factors which keep some woodland owners from putting sound forestry measures into practice. At the same time he is attempting to identify the economic incentives and expectations which stimulate others to accept professional recommendations.

As a basis for this exploration, Mr. Thompson is examining the records of each district forester. Owners having the same acreages are being selected who a) have followed the forester's recommendations, and b) have not put the recommendations into practice. The results are expected to be of much interest to administrators charged with responsibility for drafting educational and landowner assistance programs (both private and public).

Meantime, visitors to the Cape Hatteras National Seashore, six of North Carolina's eleven state parks, and the Great Smoky Mountains National Park are being interviewed by AFA's Chief Forester, Kenneth B. Pomeroy. He is determining the reactions of parks visitors to the facilities available and soliciting suggestions for improvement of the recreational opportunities within the state. Key questions are:

Would you be willing to pay a fee of 50¢ per adult per visit to be used for the improvement and expansion of public parks?

To what extent should local communities participate in development of federal and state parks?

On the assumption that many park visitors are city dwellers, they also are being asked three questions in an entirely different vein:

Do you own a farm, a woodlot, or other rural property?

Do you think private landowners have a right to prohibit hunting, fishing, picnicking, camping, or other public recreational use of private property?

Inasmuch as game and fish are the property of the state, do you think private landowners who permit public hunting and fishing should receive a tax rebate or other concession from the state?

The responses to the questions will be compared with the woodland owner interviews.

AFA'S BOARD OF DIRECTORS MEETS

THE board of directors of The American Forestry Association on June 18 heard a comprehensive report by Dr. R. E. McArdle, chief, Forest Service, on plans, programs and problems presently confronting his agency. The report, which was off the record, followed a similar presentation by Conrad L. Wirth, director, National Park Service, earlier in the year. A source of gratification to the board was the report that last month saw 1,258 new members joining the association, a new record for a 30-day period. The board also heard reports on the status of AFA's Program for American Forestry, a plan to organize a conservation teaching aids program for elementary school teachers, a proposal to establish a memorial to Ovid Butler, and a report that the multiple use-sustained yield bill endorsed by the board in February was enacted by Congress and signed by the President in June. The next meeting of the board will be October 16 at Gulfport, Mississippi.

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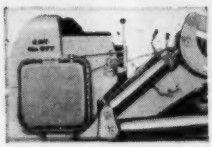

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Up 50% on the 977H—its new Cat D333 Engine develops 150 HP at the flywheel. Up 43% on the 955H with a new Cat D330 Engine that develops 100 flywheel HP.

NEW INCREASED BUCKET CAPACITY

An 11% increase on the new 977H with new 2½ cu. yd. bucket—and a 16.6% increase on the 955H with new 1¾ cu. yd. bucket. Complete redesign of engine, power train and chassis provides new machine balance to handle the heavier loads.

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Many new features, including larger, stronger track components that also increase stability . . . lifetime lubricated rollers with patented floating ring seals need no servicing . . . and track guiding guards welded to the roller frame for positive track alignment. The 955 Series H Traxcavator also features a new 6-roller track frame and hydraulic track adjusters, both standard equipment.

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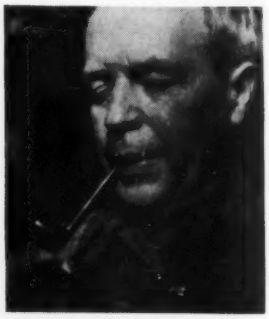
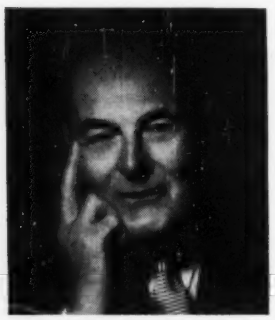
"Who's Who"
at the
WORLD FORESTRY CONGRESS

P. N. Mehra, Professor of Botany, Panjab Univ. India



Director C. S. Larsen, Arboretum, Horsholm, Denmark



E. B. Latham, member United Kingdom Forest Com.

Director C. Sirivarna, Royal Forestry Dept., Thailand

Professor J. Speer, University of Munich, West Ger.

B. Thunell, Swedish Forest Products Res. Laboratory

TWO thousand foresters from 50 nations will gather at the World Forestry Congress in Seattle next month to advance the science and practice of forestry through exchanges of information and development of personal associations among the professionals of forestry throughout the world. The significant contributions these representatives have made to forestry will underscore the dissemination of forestry knowledge and know-how at the congress.

Among these foresters, many with international reputations, will be Alexander Robert Entrican, director of forestry, New Zealand Forest Service. Mr. Entrican, who has held this position for 21 years, has introduced modern methods of timber preservation in New Zealand and has promoted an exotic export trade quarantine system. He was the founder and director of the Murupara Pulp and Paper Scheme and pioneered the *Pinus radiata* pulp and paper industry in his country. However, Mr. Entrican's primary interests have been the establishment of New Zealand's Forest Research Institute, the expansion of research training, and the conservation of the Dominion's indigenous forest resource by increasing the area of exotic plantations. Several years ago Mr. Entrican initiated a National Forest Survey—the indigenous section was completed in 1957, and the exotic survey is scheduled for completion in 1962.

Professor P. N. Mehra, who is the head of the Botany Department, Panjab University, will be a representative of India. Although on the staff of the Botany Department, Professor Mehra has pursued studies in forest cyto-genetics. He has made

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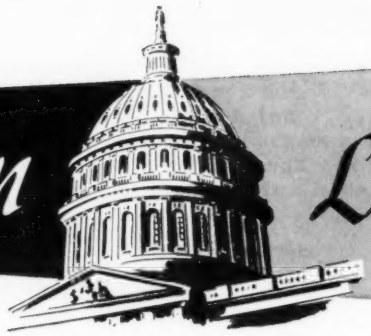
Washington Lookout



By ALBERT G. HALL

PASSAGE OF THE MULTIPLE USE BILL BY BOTH House and Senate last month, and the President's approval of the act (Public Law 86-517) on June 12, may mark the beginning of a new era in national forest management. While multiple use of the national forests has long been a concept guiding their management, Congressional action in both authorizing and directing that the forests be managed under principles of multiple use and to produce a sustained yield of products and services will provide additional authority to the Forest Service in its handling of the many, and often conflicting, demands of forest users. The act may also, as its sponsors have hoped, reduce some of the pressure for transfer of areas of high recreational value from national forest to national park status. The bill underwent several clarifying amendments, but in retrospect they now seem unimportant: the act was declared not to be in derogation of, but supplementary to, the basic act establishing national forests; wilderness was recognized as a national forest use; the rights of the states to the control of wildlife was spelled out. Of interest are definitions of "multiple use" and of "sustained yield," two terms the meanings of which were not clear to the layman and, we suspect, to others who have used them freely in the past several years. The statutory definitions as provided by Congress are:

> "'Multiple use' means the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and co-ordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return of the greatest unit output." "'Sustained yield of the several products and services' means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land."

CONGRESSIONAL DECLARATION OF THE POLICY "that the national forests are established for outdoor recreation, range, timber, watershed, and wildlife and fish purposes," without priority except as importance may be dictated by local or regional circumstances and pressures, received widespread support both in and out of Congress. The support, in large part, may be attributed to public confidence in the U. S. Forest Service, as competent judges of values and as managers of natural resources. There remain many questions concerning the "how" of administering such a directive: Will the act open the door to increasing pressures for recreational uses to the detriment of economic uses for timber and range? How much will the reservation of selected scenic areas for primary use for recreation affect cutting budgets and the costs of timber management, including the ultimate cost of wood and wood products? Will it remove some of the "steam" from proposals for additional wilderness areas and the preservation of existing ones? Will it offset pressures for national park expansion at the expense of national forest management? Will it cause the Forest Service to

(Turn to next page)

operate in a "fish bowl" with every organized segment of national forest users examining every management decision to assure that its special interest is properly weighed and assured of sustained yield?

DEPARTMENT OF AGRICULTURE APPROPRIATIONS

as resolved by Senate-House conferees after substantial additions to some items by the Senate, include $83 million for Soil Conservation Service operations, $35 million for watershed protection, $18 million for flood prevention, $10 million for the Great Plains conservation program, $242 million for the Agricultural Conservation Program, $330 million for the conservation reserve of the Soil Bank, and $67.4 million for Extension Service.

THE USE OF MASS BIOLOGICAL CONTROLS IN

agriculture and forestry to protect crops and trees from insects and diseases has aroused both public health officials and wildlife organizations as to the probable effects on human and animal life. Research is being conducted in these areas. A bill for the protection of wildlife has been reported by the House Committee on Merchant Marine and Fisheries. Introduced by Representative Wolf of Iowa, it is similar to one earlier introduced by Senator Magnuson of Washington. It provides that the Fish and Wildlife Service of the Department of the Interior be consulted in advance of the beginning of any federal program for large-scale pesticide use. Both the Department of the Interior and the Department of Agriculture oppose the bill on the ground that it is unnecessary—both departments are in accord with the objectives but point out that such consultation is already taking place.

REORGANIZATION OF CERTAIN FEDERAL LAND

functions as proposed by the President in Reorganization Plan No. 1, and as amended by the Congress, have been enacted into law. They do not change federal authority, but will have the effect of streamlining activities of the Department of Agriculture and of the Department of the Interior in relation to national forests. As the real estate office of the federal government, and as administrator of the mining laws, the Interior Department has been called upon in many cases to duplicate work done by the Forest Service in effecting land exchanges, in the disposal of small tracts of land, and in the sale or other disposal of sand and gravel from national forest areas. Under Public Law 86-510, signed June 11, the authorities for such actions have been transferred from Interior to Agriculture. This transfer of authority does not affect the basic mineral laws.

A PROGRAM FOR INCREASED INDUSTRIAL USES

for agricultural products, including forest products, has been hung up among Senate-House conferees, after each house last year passed bills similar in objective, but vastly different in proposed administration. Purpose is to provide federal leadership in research and demonstration leading to commercial production of industrial commodities from surplus agricultural crops and from forest woodland trees, especially low-grade trees and species for which there are little or no markets. It is expected that the differences will be resolved and that a program will be authorized prior to the adjournment of Congress.

NATIONAL FOREST ACCESS PROBLEMS WILL PROB-

ably be accentuated as multiple-use pressures continue to arise. While the government has the power to condemn rights-of-way across private lands, the Forest Service has been reluctant to resort to condemnation. Rather, it has sought to negotiate with adjoining landowners. Similarly, private timber owners whose areas may be blocked or checkerboarded with federal lands have had the right to demand ingress and egress. Here again, in most instances, friendly negotiations have provided for both federal and private land managers the necessary access to their operations. In some instances this has not been the case. The opposition of the larger forest proprietors has been aroused by a proposal to require that private owners give up some of their access rights and the use of their private roads in return for the right to cross government land. Industry spokesmen for the larger land-owning corporations have declared that the proposal, if enacted, would be unconstitutional, that private owners would be inadequately compensated for the taking of their road systems, and would be denied access to the courts for determination of fair values. On the other hand, some smaller forest industries disagree with the position taken by the larger corporations. The Forest Service, which finds itself in the middle in this dispute, contends the new proposal would save the taxpayers money in the long run.

Editorial — FIFTY YEARS OF SERVICE

Foresters have long recognized the importance of research relating to wood. They have known that timber production and timber utilization are inseparable —that forests are necessary to produce wood, and that markets for wood are essential to make timber growing a profitable business enterprise.

As far back as 1884, when timberland owners, timber manufacturers, and the general public took both forests and wood for granted as resources of which there would always be an abundant supply, Bernard E. Fernow, then Chief of the Division of Forestry in the U. S. Department of Agriculture, initiated the first experiments with timber in the United States. Three years later he wrote: "The properties upon which the use of wood, its technology, is based, should be well known to the forest manager if he wishes to produce a crop of given quality useful for definite purposes." He might have added what he undoubtedly had in mind, that knowledge of the properties of wood is equally essential to assure its use for the right purposes, by the most efficient processes, and with the least possible waste.

The next step in wood research took the form of co-operation, on a very limited scale, with several universities—Purdue, California, Oregon, Washington, and Yale. At the same time the Division of Forestry began research on naval stores in the South and on pulpwood at a small experimental mill in Boston. Then came the creation of a small Branch of Forest Products Research in the Washington office of the Forest Service, to be followed in 1910 by the establishment of the Forest Products Laboratory at Madison in co-operation with the University of Wisconsin. Here at last was an institution at which federal research relating to wood could be centralized.

The results achieved by the Laboratory in the fifty years that have elapsed since that memorable date were recently celebrated at its Golden Anniversary, an account of which appears on page 32 of this issue of AMERICAN FORESTS. They constitute a striking tribute to the vision and the wisdom of its creators and to the efficiency of the laboratory staff. Innumerable problems relating to the structure, properties, and uses of wood have been explored. These have ranged all the way from making a farmer's fence posts last ten times as long to determining the reaction of wood-derived rocket fuels 10,000 miles out in space.

The laboratory's findings have benefited every wood-using industry. They have also made timber production a profitable enterprise, and they have given the public a far greater variety of better products made from wood and its derivatives than would otherwise have been available. These products include lumber, plywood, posts, poles, furniture, pencils, and thousands of other articles obviously made of wood; newspapers, bags, fibre boxes, wall boards, insulating boards, and a bewildering variety of other goods made of pulp and paper whose connection with wood is not obvious but is commonly known; and such substances as plastics, synthetic cloth, films, flavoring extracts, sausage casings, explosives, and many other chemical derivatives the wooden origin of which is seldom recognized.

Why an institution which, in its own words, is "concerned wholly with the investigation of wood and wood products and their adaptation to diversified fields of use" should be known as a "forest products" laboratory is a minor mystery. As Assistant Secretary of Agriculture Ervin L. Peterson stressed repeatedly in his talk, forests are important not alone for the wood which they produce but for "all their multiple values—recreation, regulators of water, homes for wildlife, their streams and lakes a habitat for fish, their open spaces for grazing of livestock, portions of them as wilderness sanctuaries, other portions as game sanctuaries, other portions for their scenic grandeur." Research dealing with these many other products of the forest is the task of the regional forest experiment stations, not of the Forest Products Laboratory.

The matter of terminology is perhaps of little importance ("What's in a name?") except so far as it tends to confirm the widespread and unfortunate belief that wood is the only forest product in which foresters are genuinely interested despite their proclaimed adherence to the principle of multiple use. To emphasize the fact that wood is far from being the sole product of the forest is not to belittle its importance. As Secretary Peterson said: "For the present, and for some time to come, the basic economic value to support forestry investments necessary to multiple use and sustained yield management is the value of the wood the forest produces." This fact would be clarified, not obscured, by use of the word "wood," rather than "forest products," when wood is the particular forest product involved.

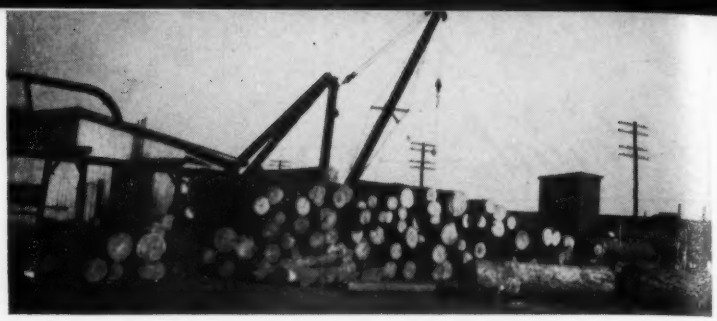
Whatever its name, the Forest Products Laboratory will continue its efforts to make wood—"the universal raw material," "the universal friend of man"—an even more valuable resource than it is today. Wisely, the laboratory is increasingly devoting its attention to basic research dealing with structure, properties, and processes. Applied research is more properly a function of industry.

That much still remains to be learned is evident from the fact that there is still no complete answer to the simple question, "What is wood?" Everybody knows something about it, but nobody knows everything about it. It is at once more familiar than the proverbial old shoe, and still so mysterious that persistent chemists have not unlocked the secrets of some of its molecules. And as in all fields of knowledge, the solution of one problem poses another. There is no present indication that our knowledge of the world in which we live will ever be complete or that scientific progress will eventually reach the point of diminishing returns.

The American Forestry Association congratulates the Forest Products Laboratory on fifty years of outstanding service. May it achieve even greater success in the next half-century in advancing the frontiers of knowledge of one of our most useful raw materials.

(by S. T. Dana)

For generations the people of the area have mined coal, limestone, and timber



Producing at full potential, the forests could support several times the present number of woodworking plants

Farm lands were abused, then abandoned resulting in acres of eroded gullies and washed-out interfluves

Pine plantations have been planted on some eroded area

NATIONAL FOREST

IF the term "national forest" automatically evokes in your mind's eye endless vistas of pristine forests, uncorrupted lakes, and awesome mountains, you ain't seen Hoosier National Forest. Not that the only national forest in Hoosierland does not have a charm of its own. Far from it. Gentle, undulating hills interspersed with ravines as deep as 400 feet dominate the area. In the spring, redbud and dogwood perform kaleidoscopic tricks that beggar description. In the fall the mauves, the golds, and the yellows almost make the eyes ache with their undiluted grandeur as maple, oak, sweet gum, and poplar perform their annual strip-tease before the descent of winter's leaden curtain.

But all the ecologic splendor of changing seasons and their pyrotechnic bravery cannot hide the eroded gullies and washed-out interfluves. Here is land that has been abused, abandoned, and condemned to ignominious decay. It stands as a mute indictment of man's unconcern for his environment and his disregard for what Albert Schweitzer calls "the web of life."

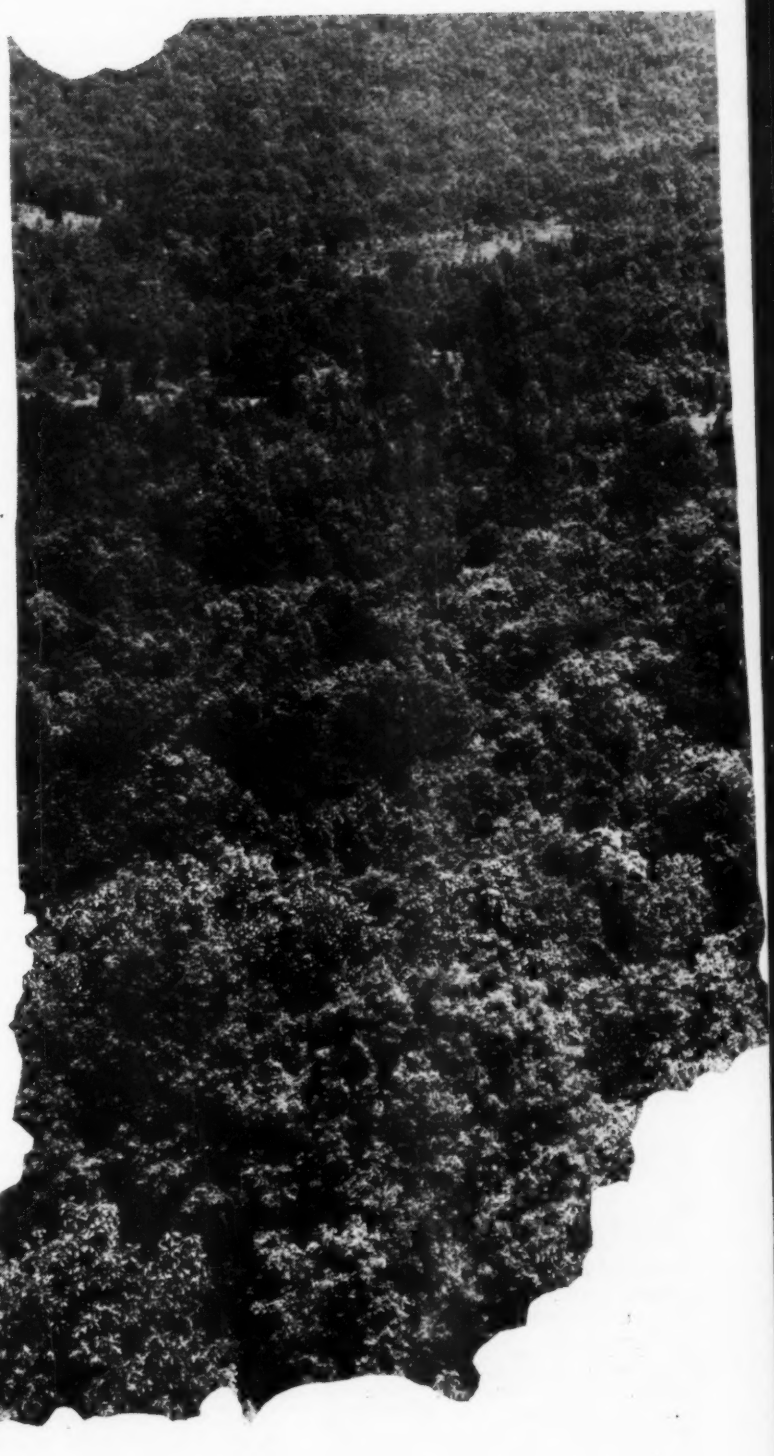
In 1935 it so stirred the conscience of the people of Indiana that the state legislature adopted an enabling act permitting the federal government to buy land in the area for the purpose of establishing a national forest. Some 722,460 acres were designated as eligible for inclusion in the national forest. But as of now, a quarter century later, only 119,131 of these ailing acres have found their way into the forest infirmary operated by the Forest Service. And, judging by the pittance Congress has allocated for land acquisition purposes in the current budget, the snail's pace hardly seems destined to improve.

Those of us who love and appreciate the scarred and battered acres of this area have known frustration, anger, disappointment and fear. We have argued, begged, pleaded, and threatened for more realistic consideration. But the Congressional mills continue grinding ponderously. Most of us long since have become reconciled to the fact that the Hoosier National Forest appears destined for a stepchild's role for years to come, unless the plight of the area can be dramatized.

In making the world, God seemed to smile generously on northern Indiana. He endowed it with some of the most fertile farmland in the nation. But then, as if embarrassed by His prodigality, He shortchanged the southern half. Instead of deep and stable loam, He covered the southern counties with clay and shale sandstone and loess—all thinly iced with a glaze of topsoil. But He must have reflected on His handiwork a second time, for He ameliorated His first harsh decision by placing under the meager topsoil an

Aside from its timber-growing potential area has fine recreational possibilities

One-third of the area is suitable for farming if the hills are protected from erosion



ESTS OF INDIANA •

By PETER TERZICK

almost endless wealth of coal and commercial grade limestone.

For generations the people of the area have mined the coal, the limestone, and the timber. When the first settlers came, the hills were covered with deciduous hardwoods. Logging and lumbering provided supplemental employment for the homesteaders endeavoring to build farms out of robust but heavily leached soil. First crops were good, but fertility soon dropped off. One by one, farms were abandoned as pioneers moved on to more promising areas. Cropping and erosion left their indelible marks. So did fire and flood. But the land struggled to heal the wounds and become whole again.

Discovery of wide veins of coal close to the surface ushered in still further trouble for the unhappy land. Great areas were gouged and blasted by mechanical monsters of

(*Turn to page* 82)

Only a short distance from teeming New York City
the urbanite can enjoy the serenity of an actual wilderness area

The Hemlocks of MIANUS GORGE

Lower Manhattan as seen from Brooklyn

By ALEXANDER B. ADAMS

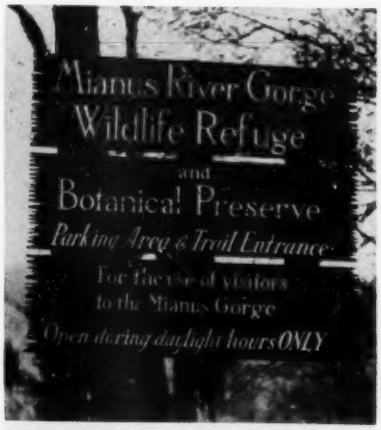
JUST a few miles from New York City, on the Connecticut-New York line, is an ancient stand of hemlock trees, some of them many feet in diameter and a number of them more than three hundred years old. Growing on the steep slopes of the Mianus River, which winds through the countryside toward Long Island Sound, they contrast sharply with the second growth common in the surrounding suburbs and form an island of climax forest in the midst of the expanding metropolitan area.

Here, especially on weekends, come people from nearby communities to see how the forest once looked. Children from Brooklyn and the Bronx, whose knowledge of the outdoors has been limited to city playgrounds and cement sidewalks, make their first acquaintance with America's wilderness. Others, who have had more opportunity to study nature, find among the trees of Mianus relief from the city's tensions. Sitting on a fallen log and listening to the wind in the upper boughs of the hemlocks or the creaking of two trees rubbing against each other in a summer breeze, they wander again in the deeper forests that they may have visited in the past.

The story of these trees, how they came to be at Mianus in the first instance and why they are still there in spite of the building developments springing up near them, has two parts. It starts with the glacier and then, with increasing tempo, ends with a race against time by a handful of people who wanted to preserve the area as a nature refuge and succeeded in the face of apparently insurmountable odds.

The first part begins when the glacier, which once lay so deep across Connecticut and New York that it would have almost buried the Empire State Building, commenced its slow retreat north, leaving behind a barren, scoured land. Gradually, as the days grew warmer, various forms of vegetation entered to fill this void. First, they resembled those of the tundra. Then came the northern forests and finally the trees and shrubs that grow in the area today, among them the Eastern Hemlock that now lines the banks of the Mianus River.

The exact place of the hemlock in these successive waves of plant life is not fully understood. To some, it is a relic of the more northerly forest, one that suffered extensive buffeting by the truly northern forests and the more southern ones, as the glacier advanced and receded. To support this theory, these scientists cite, among other points, the hemlock's seeming preference for the cool slopes of deep ravines. Others believe that the hemlocks are the natural climax tree of this region, held in a state of supression primarily by the interference of man. Both fire and cutting, they point out, are particularly injurious to hemlocks. A fire that may leave other trees relatively undamaged can completely destroy a planting of hemlocks. Furthermore, because hemlocks cannot sprout from their stumps like many other trees, cutting an area will not only eliminate the hemlocks already growing there, it will also destroy the seed supply of the future. If it were not for these factors, say one group of authorities, the hemlocks would invade the surrounding woods. As it is, they have been driven back to the ravines,



Sign welcomes visitors to ancient stand of hemlocks

In this natural area fallen trees are not removed

In winter, the Mianus River runs through snow-covered rocks below the steep hemlock slopes

because these places are less susceptible to fire and also have not been worth clearing in the past.

Unfortunately, the evidence on either side of this discussion is obscured by the absence of accurate records telling about the natural state of the woods when the first settlers wandered through them. Many descriptions do exist, but unfortunately the Indians of southern New England had already upset nature's balance by starting many fires. They did this to make the woods more passable and also to encourage the growth of browse for deer, but wherever it happened, the hemlocks were destroyed.

How the trees came to exist at the edge of the Mianus River depends, therefore, on how the history of the region is read; but there they grew, protected by the inaccessibility of the steep slopes above the river. While more level farming and building sites were available, there was no point in clearing land as rugged as this. So, over the years, many nearby residents came to know and love the hemlocks. On their free days, they wandered under the hemlocks' heavy shadows and felt underfoot the soft cushion of centuries of needles. Occasionally, they said that something should be done to preserve the trees for future generations.

Mrs. Anthony Anable, who lived with her husband in nearby Stamford, Connecticut, was one of those that loved the hemlocks of Mianus, but she realized that time was running out. With the post-war expansion of the New York City suburbs, it would only be a question of a few years before the hemlocks fell to the onslaught of the bulldozer. Consequently, she assumed the seemingly impossible job of joining together the many people who had expressed an interest in the area and translating that interest into steps that would make the protection of the hemlocks possible. One evening, at a party, she met Robert Hamershlag, also a nearby resident and another of the gorge's admirers. From him, she obtained the name of James Todd, who was familiar with most of the landowners in the area and could tell her who held title to various sections of the gorge. With these two men, who were willing to give her time and help, she now had a nucleus of well-informed people enlisted in her cause.

Her next step was to gain the endorsement of a group of scientists. There was no question about the aesthetic worth of saving the hemlocks, but she knew that her case with the public and with interested landowners would be greatly strengthened if she could show that the undertaking also had scientific value. So, in December, 1953, she led a group of carefully-chosen men through the gorge. Among them was Richard H. Pough, author of the *Audubon Bird Guides*, an ecologist and, at that time, president of the Nature Conservancy, an organization concerned with preserving natural areas.

The reaction of the group to Mrs. Anable's proposal was enthusiastic. As Mr. Pough later said, "We know of no other comparable tract of what appears to be virgin, or at least mature, forest anywhere in southwestern Connecticut or in fact in the entire New York City region."

Encouraged by their approval, which heightened her own previous beliefs, Mrs. Anable tried to decide which pieces of land should be purchased first, how much they would cost, and whether the money could be raised. Even a cursory survey showed that the heart of the proposed refuge should be a sixty-acre tract that lay along the river. It contained the largest hemlocks and was essential to the undertaking.

But before her plans for acquiring this tract were completed, the first of a series of crises confronted Mrs. Anable. In the local newspapers appeared a small notice that a water company intended to dam the Mianus River below the gorge and create

a reservoir. If this plan went through, the gorge would be lost.

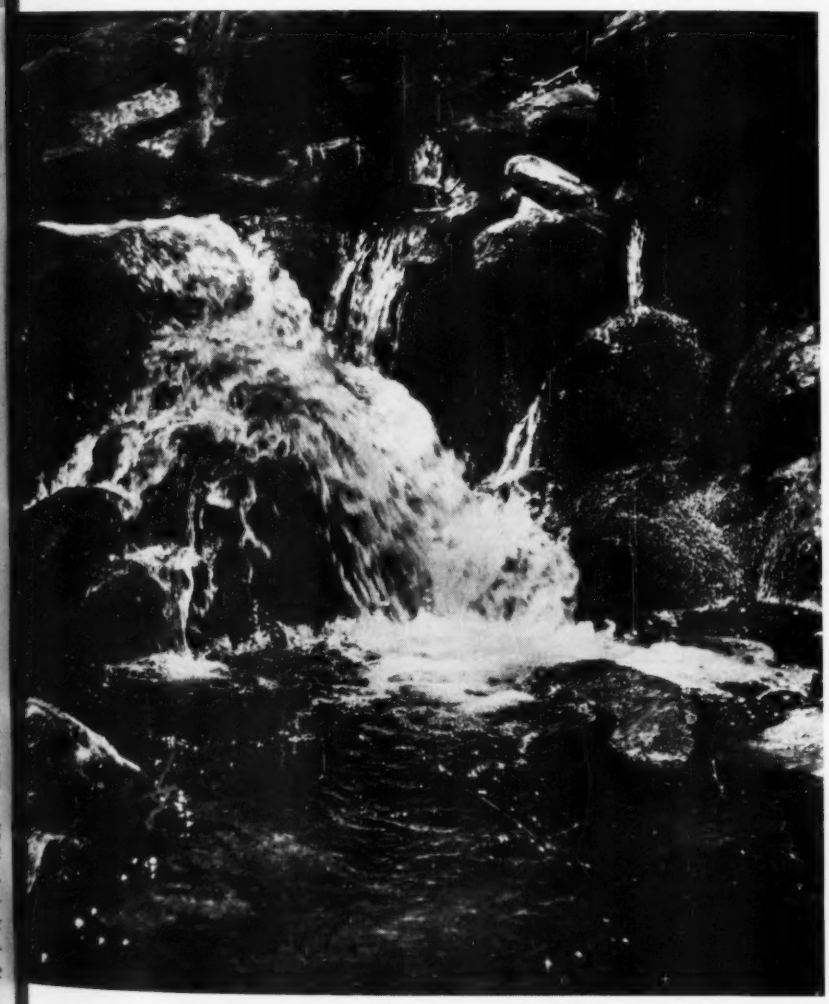
Little could be done in Connecticut, where the dam would be built, but because the reservoir would cross the state line into New York, the water company had to secure the permission of the New York Water and Power Control Commission. Public hearings were scheduled for March and April, 1954.

Mrs. Anable and Mr. Todd undertook the task of appearing before the Commission and objecting to the reservoir. But first, they sent out urgent appeals to nearby Audubon and garden clubs, as well as other conservation groups, so that when they testified before the commission they spoke as representatives of large numbers of residents.

Knowing that their efforts to save the gorge and its trees should not be limited to blind opposition, they spent many long hours in preparation, studying alternative sites as well as the present and future requirements of the district to be served by the reservoir. In the end, they were not successful in preventing the erection of the dam; but their arguments against it had been sufficiently well informed to make the commission take two important steps. First, it limited the height to which the water could be raised. Second, it granted permission to the water company on one specific condition: "This land," said the commission, "must be used for water supply purposes only and so far as shall be consistent with such use; the

A young boy examines a giant hemlock

Into the Mianus River pours one of its tributaries, running down the steep banks



said land shall forever be kept in its natural state."

It was not the complete victory that some of the witnesses at the hearing might have desired, but the most important part of the gorge was saved from submergence and the surrounding areas would not be lumbered. Now Mrs. Anable and her group could turn their full attention to raising money and acquiring the necessary land for the refuge.

Then on New Year's Eve, 1954, Mrs. Anable's telephone rang. The owner of the essential 60 acres wanted to speak to her. A real estate developer, it seemed, was also interested in buying the land and was pressing for an answer. However, if Mrs. Anable wanted it, she could have it for $30,000, the first payment to be ten per cent of the final price. But, said the landowner, an acceptance or refusal had to be made immediately.

This was another crisis for Mrs. Anable. New Year's was not the ideal time to raise $3,000 in cash and the promise of $27,000 more, but she undertook to do it. Three admirers of the gorge were willing to sign personal notes for a thousand dollars each, so that the down payment could be borrowed from a bank. Furthermore, they expressed confidence that somehow or other

(*Turn to page* 86)

BLIGHTS ON THE

By MICHAEL FROME

In traveling across the face of America, as millions of vacationers are doing this summer, the national landscape is much changed in comparison with even a short decade ago, and it is still in the process of changing. Apart from the unending growth of cities, where people live, the open spaces and all the places we go to enjoy leisure time and mobility are taking on a new look.

In some cases, the change is for the better; in others the change is incredibly awful. And, in general, tourist blight is advancing more rapidly than tourist beauty. Where will it all end? A disturbing question—one which should disturb more people as they travel over the countryside this summer.

Uncontrolled ribbon development and mammoth billboards along the highway are only part of the problem. As an amusement park located where New York meets the ocean, Coney Island serves a delightfully useful purpose. But should the Coney Island atmosphere, aflutter with pennants and sideshows, pervade coast to coast? Everyone, of course, is entitled to his own taste and should exercise it freely on his vacation; the landscape, however, is something we all have to live with and hope to enjoy, and therefore deserves far-sighted care.

The city of Ocala, Florida, is a case in point. It is swamped and surrounded with small signs and large signs pointing the way to the prominent commercial tourist attraction at Silver Springs. Ocala—the home of Silver Springs. Silver Springs, this way. Don't miss Silver Springs. You MUST visit Silver Springs. The town looks like a living television commercial, or perhaps the biggest billboard on earth.

While in the area recently, I asked a waitress if she had ever heard of Juniper Springs in Ocala National Forest, and how it compared with Silver Springs.

Yes, of course she had heard of it, having lived in central Florida all her life. But all they had at Juniper Springs, she said, was a picnic spot. The *real* place for tourists to visit was Silver Springs.

She is an example of how well the natives themselves have been mesmerized by comprehensive advertising. But anyone who wants to see and enjoy the natural, unalloyed sub-tropical Florida should visit Juniper Springs. This beautiful rec-

NATION'S *Landscape*

reation area in the heart of the national forest has facilities for tent and trailer camping, rental cabins in the pine woods, swimming in the cool, clear creek water. If you rent a canoe and start early enough in the morning, you can take the 12-mile canoe trip down Juniper Creek and find the country rich in animal and bird life — deer, otter, turkey, alligators, blue heron, egret, kingfisher—the same creatures the Seminole Indians knew when they alone were in these parts.

Equally enjoyable is the newer recreation area in Ocala National Forest at Alexander Springs, where the water bubbles upward from cavernous underwater springs, as clear and turquoise as the Caribbean, with schools of fish flittering about. Although the Ocala waitress had never

Williamsburg, Virginia is an outstanding example of refinement in tourist attractions

heard of Alexander Springs, she too would probably enjoy the paddle-wheel boat trip on romantic, winding Spring Creek—even without a glass bottom.

Florida is bursting out with so much newness—real estate developments, industry, hotels and motels, man-made tourist attractions—that its unique, timeless qualities are being overwhelmed and obscured. Driving down the west coast from Ocala, the major route now abounds with directions to new sub-divisions, Stuckey-type roadside stands and the like. Yet if you choose a lesser road, such as State 476, you will pass citrus groves, cattle ranches with Brahma cattle at pasture, tree plantations, white egrets and water lilies sharing a roadside pond.

On the way you can stop at Dade Battlefield Historic Memorial, near Bushnell. Though little known, and too little promoted by the state, it is one of the most historic sites in the Southeast, the scene of the opening battle of the Second Seminole War in 1835, a kind of early-day Custer's Last Stand. The Seminoles, under Osceola, had refused to be uprooted and moved west, or even to recognize the U. S. Government; here they massacred a force of 110 under Major Francis L. Dade. Today the battlefield park comprises 80 beautiful acres, with palmetto, live oak and magnolia, playground and picnic facilities, monuments to the massacred soldiers, and an excellent museum recounting the history of the Seminoles and the early white settlement.

Tourist blight appears in varied forms. Among the poorest are the snake pits and caged bear attractions which North Carolinians offer the visitors in the western mountain corner of their state. Stop at a roadside souvenir stand outside the Great Smoky Mountains National Park for a closeup of a pathetic caged bear. You can buy a coke, give it to the bear and watch him drink it—and you pay only for the coke. How are these poor creatures cared for? How were they captured in the first place? These questions once were asked briefly in the North Carolina legislature, which chose to preserve the blight and overlook the problem.

Then there is the reptile "garden" in the area, which everyone who loves wild creatures should see—not because it is good, but to observe how the animals, scraggly deer, sheep, a bear, as well as the snakes, are cared for. More North Carolinians, including newspaper writers and the members of the state tourist commission, should inspect it too. Can this really be the type of attraction they would have out-of-state visitors pay money to see?

Anywhere you go in the United States there is tourist blight, but more now than ever. At Gettysburg, Pennsylvania, Stuckey's garish red and yellow roadside stand, accompanied by Texaco's Fire Chief, stands in the heart of the greatest battlefield on the American continent, disproving Abraham Lincoln's words that "the brave men, living and dead, who struggled here, have consecrated it (the battlefield), far above our poor power to add or detract." And in the Southwest, Route 66 between Albuquerque, New Mexico and Flagstaff, Arizona is probably the nation's most bilious highway, with more signs about more types of attractions than any other road section twice or three times its length.

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Palm-studded shoreline and the lily pads of Alexander Creek may be seen on cruises

Tropical scene along nature trail in the Juniper Springs Recreation Area in Florida

Timber Rights of Life Tenants

By JOHN WARREN GILES

John Warren Giles

Mr. Giles is a distinguished lawyer of Washington, D. C. A graduate of Columbia College and Columbia Law School, Mr. Giles is a member of the Bar of New York, Illinois, and the District of Columbia. He is a former professor of law at the Catholic University Law School and the University of Kansas. Besides practicing law, Mr. Giles is a writer for several national magazines on legal subjects.

EVERY full grown tree lives in mortal danger of destruction by the axe and the cross-cut saw, but the trees which have reached maturity on the lands of a life tenant have a better chance of living to a ripe old age.

There is a basic principle in American law which underlies all the various rules governing the actions of a life tenant respecting the timber on his property. Naturally this rule is founded on principles of prudent and proper husbandry. In essence, every life tenant is entitled to cut timber from the land for fuel, fences, the erection of necessary buildings, and for improvements to the property.

In the early days of England, where woodland has always been held at a high premium, it was, in every case, waste for a life tenant to cut the timber for the purpose of clearing the area and converting it into arable land. The British felt that this was definitely an injury to the inheritance. However, when our ancestors came to America, then the greatest of forests, this British concept gave way to the idea that the land was much more valuable after it had been cleared. Hence the strictness of the English rule has been much relaxed in this country, and what constitutes waste depends largely upon the locality of the property and the extent and value of the timber.

It does not seem surprising that a tenant for life may take a reasonable amount of firewood necessary for fuel. However, it is very clear that the fuel must be used and actually consumed on the premises for the use of the tenant and his servants. You must not cut rail timber for firewood when there is other wood that may be used for that purpose. Of course, if it is a custom in the community to use oak trees for firewood, it is proper to cut them for that purpose.

In New Hampshire it has been held that a life tenant of a 165-acre farm is not entitled to cut wood for the dwelling of a farmer who labors on the place, in addition to the firewood required for the mansion on the property. Nor can a life tenant cut timber and then exchange that timber for firewood. It is not amazing that a life tenant may take timber for the purpose of repairing buildings or fences on the property. In this connection a tenant for life has no right to cut and use for fencing purposes young and growing timber which would not make more than four or five rails to the cut. These fences and buildings must be fences and buildings which have been on the premises since the commencement of the tenancy. You cannot take the trees from the premises for the purpose of building a new house or a new barn or new fences. Nor can you cut off the timber which is not suitable for fencing, sell it, and use the proceeds for the purpose of purchasing timber suitable for that purpose.

A Texas court has said that you can use the trees for the purpose of erecting log cribs or a log cabin in which to live. This question has been raised in no less than thirteen states, and the holdings have been more or less unanimous.

Can you fell and remove dead and dying trees which are standing in open fields in such a position as to obstruct the cultivation of the fields, where good husbandry requires their cultivation? Pennsylvania and Arkansas courts have held that you can. In England it has been held that a tenant for life may cut down oak, ash, and elm trees under twenty years of age, provided they are cut for the purpose of allowing the proper development and growth of other timber in the same wood or plantation. The thinnings of fir trees under 20 years of age belong to the life tenant.

If some of the trees on the property require periodical trimming in order to preserve the remainder of the trees, you are well within your rights in so doing.

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Dr. Edward C. Crafts

BILLS, BILLS, BILLS

By JAMES B. CRAIG

Helping Congress ride herd on all the bills affecting Forest Service programs and policy is a big job. How to do it? Always level with the legislators and tell the truth says Assistant Chief Edward C. Crafts

HELPING Congress to study and weigh the increasing number of bills introduced that would affect some phase of Forest Service management has become one of the most exacting and painstaking jobs carried on by the Forest Service.

The job has always been an important one, for it is closely entwined with the development of Forest Service policy. Today it has become greatly intensified. There are now 437 members in the House and 100 in the Senate. They introduce upwards of 15,000 bills in any one Congress, and today, as a matter of practice, the Forest Service checks them all.

Here's the reason why. When one considers the scope of the state and private, research, and national forest programs of the Forest Service, it is easy to understand why the activities of this one agency cut across more cross-sections of American activity than most other federal bureaus. Most any bill affecting land and people can conceivably contain at least a phrase or two of consequence to Forest Service policy, and often they do.

By actual count, the Forest Service followed 680 bills on a day-to-day basis in the 86th Congress—each having a direct and specific bearing on Forest Service programs. This is more than twice as many as the number followed in the 83rd Congress (1951-52)—and the number in each case does not include appropriations, general personnel, property, or other bills of a government-wide nature.

Congress has become more and more impressed by Forest Service efficiency in recent years, and the Service is proud of that fact. At the same time, it has added to the work load of the Service's legislative liaison arm. The request for such service from Congressmen has literally skyrocketed in recent years.

All told, the Forest Service prepared reports on 380 bills and proposals for the 86th Congress, or over three times the number made for the 82nd. Forest Service representatives testified before Congressional committees on about 30 of these bills. During the years 1951-60, a total of 200 bills were enacted which directly affected Forest Service activities, 34 of which were passed by the 85th Congress. Fully as important as the bills enacted are those that are sidetracked that would have proven detrimental to the public interest.

Where do all of these bills come from and why, you might ask? Some of them have to do with state and private forestry programs. Others deal with research. But the great bulk of them have to do with the uses and services provided by the national forests—the 181-million acre estate in which every man, woman, and child in America owns one share of stock. As visitors to these forests know, they are managed by the Forest Service under the Department of Agriculture. To carry on this managerial job as landlord and trustee requires 11,000 trained men, and at times a peak of 30,000 employees, working in 10 regions on 151 forests—all with their own individual problems, both geographical and otherwise. As managed under multiple use for "the greatest good for the greatest number in the long run," all the uses of these forests are on the same administrative plateau: recreation, water, timber, range, and fish and wildlife management.

Any areas so vast and of interest to so many people for so many different reasons are bound to have their share of problems, even under normal conditions, and they do. But conditions today are not even normal as judged by previous standards. The nation is experiencing a population explosion. This in turn is creating demand for more goods and services from our forests—demands that we maintain and even augment the highest standard of living the world has ever known.

This sort of thing is spelled out in more bills in the legislative hopper. They are drawn by individual congressmen and senators seeking to fairly represent the requirements of their various constituencies. They are drawn by myriad organizations and groups representing special interests and special uses. They are frequently inspired or drawn by still other groups—those who intend to "keep the heat on" in terms of maintaining high management standards or gradually correcting existing land abuses. The Forest Service itself and other bureaus of government not infrequently draft legislation of this type—bills that, in short, will prevent the deterioration of the public property.

With the help of Congress and the Executive Branch, the Forest Service is moving resolutely to meet these mounting pressures. An "Operation Outdoors" program has been started to improve recreational opportunities on the forests. A "Program for the National Forests" won immediate public acclaim when presented last year by Agriculture Secretary Benson. This program, if supported by American tax dollars, will represent an investment that will pay great dividends in years ahead. More recently, Congress in effect presented the Forest Service with a new charter when it directed that the forests be managed under multiple use and sustained yield principles, and that all the basic resources of the forests are given equal priority under the law.

These are all good things. Even so, concensus is that pressures on national forests will continue to increase in the crucial years ahead. This will be reflected in part by more and more bills on the part of a Congress that indicates it intends to take a more active hand in public land affairs.

This worries some AFA members, particularly old timers, who have expressed concern over this growing rash of bills, the fear that the national forests might be "legislated" to death and their strength diluted. On the other hand, the top legislative specialist in the Forest Service, Dr. Edward C. Crafts, does not concur with those who hold this view.

"All land administrators like flexibility, of course, and this is particularly apt to happen in the case of young and hustling new bureaus," Crafts told us recently. "But young bureaus, if they are any good, have

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John C. McNie uses axe to estimate depth of char on large ponderosa pine

A towering pine crashes to the ground in a fire-blackened forest of El Dorado County, California

Fire is only the beginning

By WAYNE G. HUBBARD and ALBERT S. HUNTER

WITHIN a single 36-hour period, a rash of fires in richly productive forests of northern California etched a pattern of destruction which touches the life of every American who values his country's natural resources and the colorful history of the Old West. In those few hours, young, growing trees on 50,000 acres were destroyed, and enough timber to build a city for 75,000 residents was burned. This volume of more than 500 million board feet is eight per cent of California's annual lumber output. The fires occurred at a time when the Pacific coast state already appeared to be labeling 1959 as a record year for fire losses. Final estimates of damage ran as high as $66 million in timber and watershed alone.

No scale can measure the scenic value of the land in historic El Dorado County, birthplace of the forty-niners' gold rush, which for decades will bear the ugly scars inflicted by the flames. There, the fires spread through vigorous stands of pine, fir, and cedar which were to have provided the setting for the Ice House Reservoir recreational development now under way about 25 miles east of Placerville. Selected sites for campgrounds and picnic areas around the development were denuded of 30 years' growth of trees, and the famed Ice House building, which gave the area its name, was leveled.

The Ice House, a popular landmark since the turn of the century, was exactly what its name implies—a place where ice was cut and stored after being lifted from a pond nearby. It was the supply center for most towns in the area, but had been abandoned for many years.

A portion of the old Pony Express route from Sacramento, California to St. Joseph, Missouri ran through the area of the Ice House fire. If plans to retrace the trails of the intrepid express riders are realized during the 1960 centennial, participants will see a forest without trees, the aftermath of a wildland tragedy. Transcontinental telephone lines that parallel the Express route were broken and service temporarily disrupted. The same fire also swallowed a Girl Scout camp. Rangelands were burned and wildlife cremated.

In the public mind, these immediate losses would spell the end of the forest fire story. In reality, it is only the beginning, for the toughest fight starts after the flames are extinguished. Such is the case in El Dorado and five other northern California counties, where the fires on both public and private lands paved the way for what could be a virtual epidemic of disease and insects.

Speedy salvage operations are essential to curb the insect population, which thrives on weakened timber and annually takes a higher toll in California's woodlands than do forest fires. According to John C. McNie, chief forester with the Michigan-California Lumber Company of Camino, El Dorado County, which was the biggest loser in the 36-hour onslaught: "Our main problem has been recovering usable material before it was destroyed by insects. We are also concerned that the insect population within the remaining green timber may be so large that an epidemic will result."

McNie manages the company's tree farm, set up and certified under the American Tree Farm System, which requires that the land be operated on a sustained-yield basis. The company suffered losses on 8,500 acres of valuable timberland, 10 per cent of its total tree farm acreage; at the height of the blaze, McNie had already started thinking in terms of recovery. By helicopter, he traveled in the wake of the flames to survey the extent of destruction and assess the amount of salvageable timber.

Within days, his company and a group of 15 contractors started the logs rolling. Men and machinery moved into the ash-covered woods, which had been closed for the winter. Abandoned logging roads were reopened and new ones were pushed through to areas which normally would not have been logged for another decade. Trucks and trailers for miles around were put to work

on Operation Salvage. And before the first snow fell, more than 1.5 million board feet—enough to build nearly 100 homes—were being moved out of the area each day. "We used a system of balanced logging to cope with the insect threat and the natural deterioration resulting from the fire," said McNie.

"This means taking out all the trees, large and small, in the areas where losses were heaviest," he went on to explain. "In other places we removed the timber which, because of severe fire damage, would have been unable to withstand the ravages of blue stain, a fungus disease transmitted by insects. The important thing was to get the weakened trees out of there as quickly as possible without sacrificing to the insects timber that was already killed in the fire but was still usable."

The speedy salvage action, however, created new problems. With the normal logging season completed, mill ponds were filled and decks were stacked high in preparation for winter mill operations. McNie started several new decks wherever he could acquire space and install water lines. The sprinkling system from the water lines keeps the humidity in the log decks at a fairly constant 100 per cent, which discourages stain and insect attacks as well as wood checking and hardening.

While the logging operation was proceeding at a frantic pace, reforestation measures were not overlooked. Windrows were fashioned at higher levels of the steep slopes to lay the groundwork for spring planting and seeding.

"And there again we have another problem," McNie said. "You just can't plan on obtaining seedlings for a planting job of this kind overnight. We are not sure whether the nurseries will have planting stock for our needs and those of other companies and public land. We would like to depend on Mother Nature to do some of the job, but there are good and bad years for seed and we don't know how we'll fare this year." Also, foresters insist that trees from the same altitudinal range should be planted to enable them to withstand the local weather conditions.

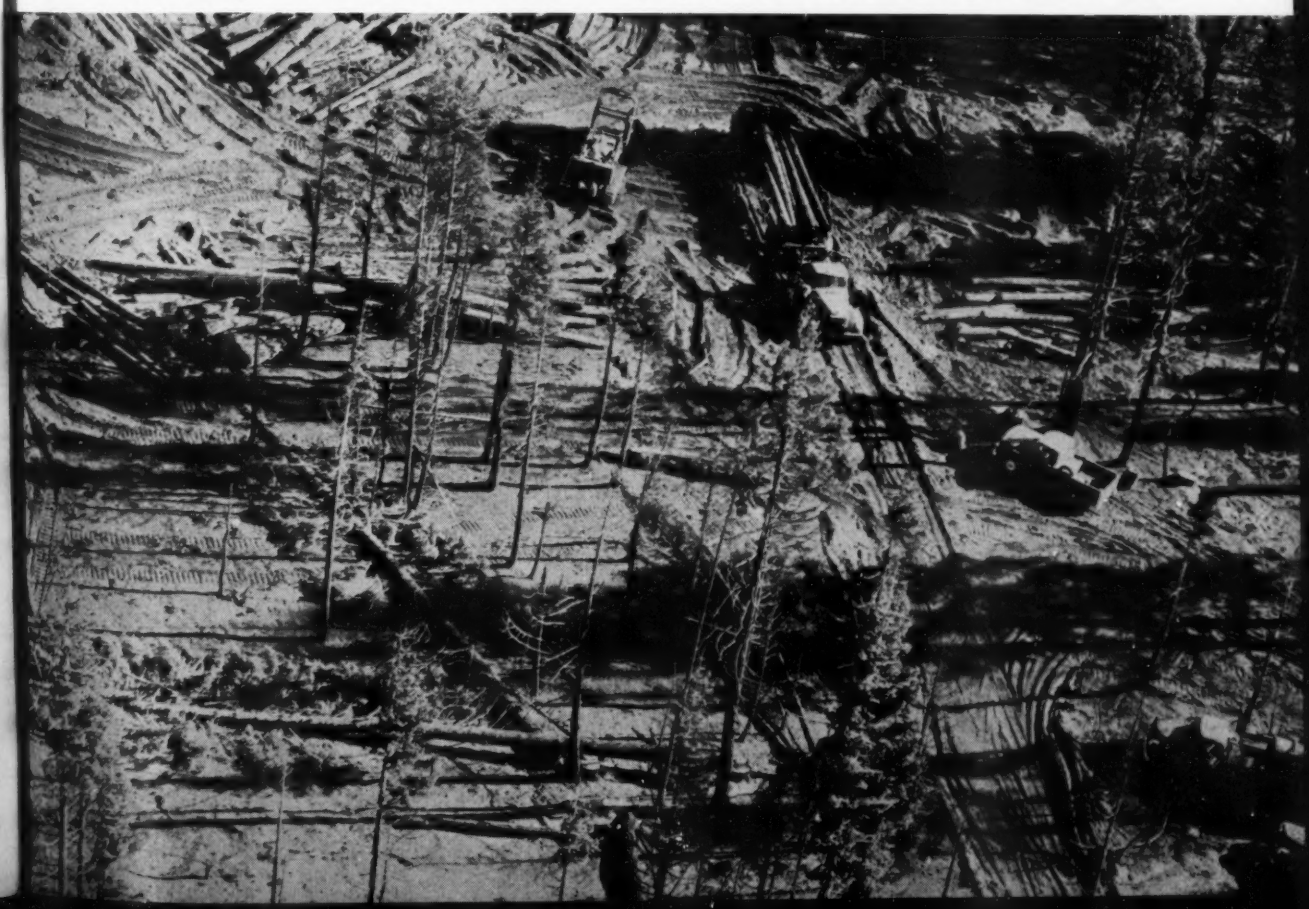
Wherever possible, McNie plans to take advantage of residual green timber as a seed source for the surrounding burned area. He states that one of the questions, as yet unanswered, is whether insects will attack this natural seed source and destroy it before the seeding job is done.

"Our tractor logging," he said, "has provided an excellent seed bed for both natural seed and our planting program. We made every effort to lessen the danger from erosion by properly using skid trails. This is important to the forest, the watershed, and the streams in the area."

Despite the fact the forest has been almost totally destroyed and much of the combustible material has been removed in salvage operations, it is ironic that a great threat from fire still exists. The danger springs from new growth of brush, the dead material remaining after salvage, and the ever-increasing number of visitors to the Ice House recreation area. This will jeopardize the reforestation program for the next five to ten years as the less combustible green foliage gradually covers the blackened timberland.

The 36-hour outbreak in California's northland has proven once again that while the forest fire is often the spectacular news of the day, the aftermath is the story of real consequence.

Once the salvage material is taken from the burned area, only a few small live trees and a good seed bed remain



Bird Songs Few People Hear

At certain times the pewee gives uninterrupted concerts for half an hour. Photo by Alfred M. Bailey

THERE were about 20 of us sitting around picnic tables on the camp grounds of Point Beach State Forest near Two Rivers, "the coolest spot in Wisconsin." It was an evening in late June, and we were resting and talking after hiking most of the day along the sand dunes of Lake Michigan and in the wooded bogs and uplands that edged the sandy beach.

The ovenbird is named for the Dutch oven shaped nest it builds on the ground Photo by Allan D. Cruickshank

The talk was mostly of birds, for this was a camp-out weekend of a group of bird watchers. We were adding up the score—counting the number of birds seen and heard on this point, which juts out into Lake Michigan.

On our list were such birds of northern evergreen bogs and forests as the Canada jay (recently renamed "gray jay"), the red-breasted nut-

In the semi-darkness of pre-dawn the kingbird sings beautiful rolling song Photo by Allan D. Cruickshank

Best songs of prairie horned lark are unknown to the casual observer
Photo by G. Ronald Austing

By CLARA HUSSONG

Photographs from National Audubon Society

hatch, and pine, Blackburnian and black-throated green warblers. Another warbler, the ovenbird, could be heard sounding out its loud, ringing "teacher, teacher," call in the hardwood forest where we had found its nest. Mornings and evenings we had listened to the silver flute notes of the hermit thrush.

Our contented, lazy talk was interrupted suddenly by a loud, rippling burst of song coming from over our heads. At the sound, we rose to our feet as one man. It was too dark to see colors, but our eyes followed the form of the little bird as it looped away into the treetops.

"What is it? What is it?" we asked each other excitedly. In our weekend of birding, we hadn't been stumped once in identifying any of the more than 80 species we had seen or heard on this point of land.

Only one birder among us, and there were veterans of 20, 30, and more years' standing, knew the answer.

"That," said a woman from Madison, "was the flight song of the ovenbird."

All of us were familiar with the "teacher bird," as this warbler has been nicknamed. We had heard its familiar call notes a thousand times, we told each other, but never before had we heard its flight song.

"Why, I've camped in the woods next to that bird for a week at a time, and never heard anything but its 'teacher' call," one of the men admitted. Some bird books don't even mention the fact that it has another song besides its well-known call note.

One of the few published descriptions of the ovenbird's flight song is found in John Burroughs' *Wake Robin*. In his day the bird was known as "golden-crowned thrush," although Burroughs points out that it is a warbler, not a thrush. Its present name of "ovenbird" was given it for its Dutch-oven-shaped nest, built on the ground.

It is the male bird which sings this beautiful song, but why it is heard so rarely even Burroughs did not know. Whimsically, he says that the bird reserves it "for some nymph whom he meets in the air."

"Mounting by easy flight to the top of the tallest tree," Burroughs says in *Wake Robin*, "he launches into the air with a sort of suspended, hovering flight, like certain of the finches, and bursts into a perfect ecstasy of song—clear, ringing, copious, rivaling the goldfinch's in vivacity and the linnet's in melody. This strain is one of the rarest bits of bird melody to be heard, and is oftenest indulged in late in the afternoon or after sundown."

A number of other birds have special songs which only a few people have heard. The kingbird, pewee and horned lark are among the birds who keep their best songs a secret from the casual bird watcher. He doesn't know they are capable of much finer performances than the

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1

An Album of Utah's

NATURAL BRIDGES

2

THREE LITTLE WORDS

THESE magnificent natural bridges are protected by the National Park Service as part of our country's heritage. They are irreplaceable. Yet, the setting of one is threatened with destruction, imperiling the bridge itself—Rainbow Bridge in Rainbow Bridge National Monument.

The menace facing Rainbow Bridge is Glen Canyon Reservoir. When the Glen Canyon Dam is completed, its reservoir will back up far enough to inundate the gorge beneath Rainbow Bridge. Unless two protective dams are built, the approach to this natural bridge will become a mud hole.

However, since the law clearly requires that national landscapes be protected from such alterations as inundation by reservoirs, if the protective dams are not built a serious precedent will be set. Other national parks and monuments could be subjected to the same misuse. Conservationists are rallying to see this doesn't happen. To help, they are merely sending postcards to their Congressmen with three little words. They are "Save Rainbow Bridge."

3

photographs by Gene Ahrens

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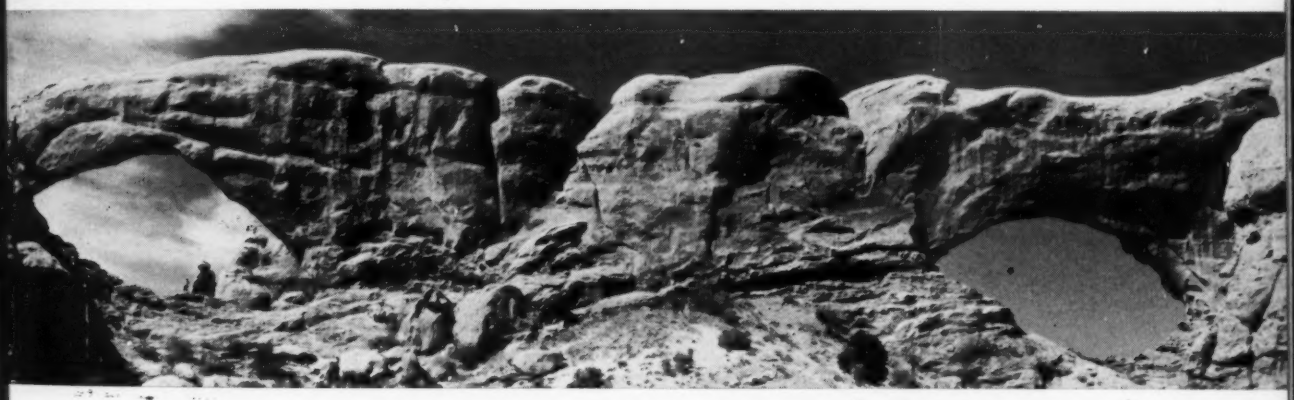

5

1—Hickman Bridge (72 ft. high, 133 ft. long) in Capitol Reef Monument.

2—In jeopardy. Famed Rainbow Bridge one of Utah's outstanding features.

3—Double Arch Bridge which is located in Arches National Monument.

4—The "Spectacles"—South Window on the left, North Window on right.

5—This is Turret Arch as seen through north window of the "Spectacles."

THE OAK:

Tree Beloved

By ROBERT L. KENNEDY

ON a hot July day in 1876, just outside the town of Tacna, Arizona, eight grim-faced men reined up their horses under a large white-oak tree. Without speaking, one of the eight unlooped from his saddle horn a coarse, greasy rope, twirled it above his head, and flicked it upward to a gnarled, bark-scarred limb. After a few moments of deathly silence, seven of the men rode out from under the spreading canopy of the oak, leaving the eighth sitting forlorn on his horse with a noose around his neck. Twenty yards from the tree the band stopped, turned, waited. Why not spice justice with a little sport? Sooner or later the horse under the oak was bound to

The famous Treaty Oak of Jacksonville, Florida

get thirsty or start grazing—or maybe the flies and insects would drive him to moseying. Then . . .

The Hanging Oak of Tacna claimed another horse thief, and another notch was hacked into the huge hatchet-chipped trunk.

This famous oak tree, with its infamous jottings, stood until the year 1917, when it died and the record of men's dark deeds was purged by a forest fire. Old-timers say it died of its wounds; some actually say the tree died of a broken heart. Whatever the truth, the fact is a thing of beauty and grandeur, "the monarch oak, the patriarch of the trees," had been misused by men.

However, such utility of the oak rarely occurs in the accounts of men.

Throughout the ages, from Malay to China, from the Himalayas to the Caucasus, from Sicily through Europe to the Arctic Circle and back down the North and South American continents, the 200 species of the oak family have inspired the poet to sing, the writer to write, and the artist to paint. The oak, as a symbol of sturdiness and strength which defies time and tempest, has given new hope to flagging spirits. How many young patriots with "hearts of oak" have gone out to defend home and country? How many times has mankind been encouraged in its struggles with the reminder that "tall oaks from little acorns grow?" The answers to such questions are mirrored in the attitude and history of people.

In England, in the days of the Druids, oaks were held sacred. At noon or at midnight these holy men went to a grove of oaks, where Deity was supposed to be present, and offered their prayers. There are some trees still standing under which the Saxon kings may have worshipped. In Athens, Georgia, was the "Oak That Owned Itself." "For and in consideration of the great love I bear this tree," wrote its owner, William H. Jackson, "I will to it entire possession of itself and of all land within eight feet of the tree on all sides." The deed, dated 1820, is recorded in

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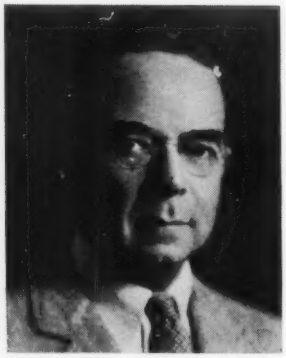
DIRECTORS OF THE FOREST PRODUCTS LABORATORY

(Photograph of George M. Hunt, 1946-51, was not available)

McGarvey Cline, 1910-12

Howard F. Weiss, 1912-17



Carlile P. Winslow, 1917-46

J. Alfred Hall, 1951-59

HALF CENTURY OF PROGRESS

By SAMUEL T. DANA

Birthplace of Forest Products Laboratory in 1910 was this building at University of Wisc

Edward G. Locke, since 1959

Youngsters watched with interest as a Lab technician broke specimens of wood in a toughness testing machine during the Lab's open house

VISITORS from all parts of the United States and from several other countries assembled in Madison, Wisconsin, on June 2-4 to celebrate the golden anniversary of the Forest Products Laboratory. Established in 1910 by the Forest Service of the U. S. Department of Agriculture in co-operation with the University of Wisconsin, the laboratory was the first institution in the world to be devoted wholly to research on wood and its utilization. Soon outgrowing its original quarters, the laboratory moved in 1932 into its present commodious, well-equipped building on a 10-acre site furnished by the University of Wisconsin.

Appreciation of the effectiveness of the activities of the Forest Products Laboratory was expressed not only by the speakers on the formal program. It came also in the shape of congratulatory messages from all over the world and of presentation of the following awards:

Prefabricated Housing Plaque from the Home Manufacturers Association.

Insulating Board Scroll from the Insulation Board Institute.

Semichemical Pulping Plaque from the American Paper and Pulp Association.

Laminated Arches Plaque from the American Institute of Timber Construction.

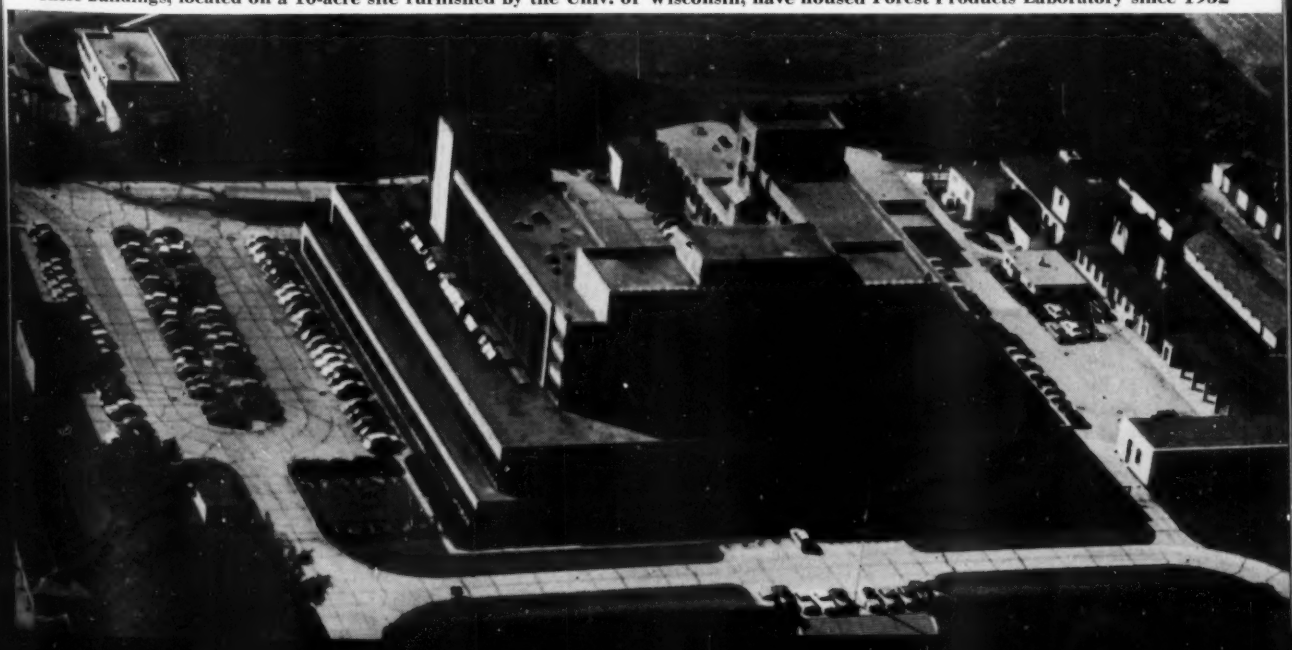
Exterior Plywood Plaque from the Douglas Fir Plywood Association.

Engineering Plaque from engineers in the Forest Service.

Of special significance was an award made by Professor Franz F. P. Kollmann, head of the Institute for Wood Research and Wood Technology at the University of Munich, who traveled all the way from Germany in order to present in person a scroll of appreciation from the German Wood Research Society to "the grandfather of wood research."

At the banquet in the Great Hall of the Memorial Union of the University of Wisconsin, nearly 500 guests applauded the presentation to the Forest Products Laboratory of the Distinguished Service Award of the U. S. Department of Agriculture—the highest award made by the department for outstanding service. On the same occasion President Conrad A. Elvehjem of the University of Wisconsin presented a citation from the university to McGarvey Cline, the first director of the laboratory. In Mr. Cline's absence the citation was accepted in his behalf by J. Alfred Hall, director of the Laboratory from 1951 to 1959.

These buildings, located on a 10-acre site furnished by the Univ. of Wisconsin, have housed Forest Products Laboratory since 1932



Frederick K. Weyerhaeuser, chairman, Weyerhaeuser Co.

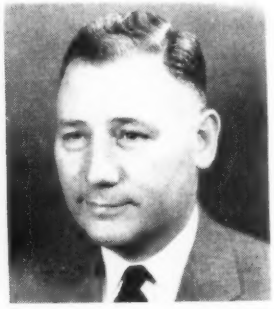
Howard E. Whitaker, chairman of Mead Corporation

John R. Kimberly, chairman, Kimberly-Clark Corporation

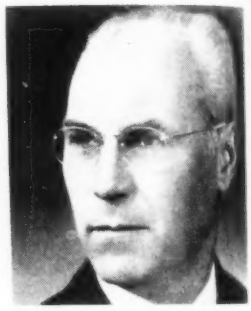
Samuel Lenher, vice pres., E. I. duPont de Nemours Co.

George E. Price, president, National Homes Corporation

Stanton W. Mead, president, Consol. Water Power & Paper



George A. Garratt, dean of the Yale School of Forestry



Frank J. Hanrahan, American Inst. of Timber Const.

Richard E. McArdle, chief of the Forest Service, quoted his predecessor in that office, Henry S. Graves, as having said that the goal of the laboratory is to enable wood to meet "in the highest degree" the real requirements of the people. He then asked: "How far have we come in fifty years?" All of the speakers agreed with his answer that we have come far but not nearly far enough.

President Elvehjem, for example, stated that we have made astonishing progress in recent years, but that modern civilization cannot remain robust on a diet of the technical knowledge available today, and that the Golden Age of Science is still in the future. He cited a conversation between two government scientists, one of whom said: "There is no question in my mind that within the next 25 years America will become the intellectual center of the world." Said the second: "If that's the case, we'd better get started." President Elvehjem continued that "the moral of the story, if it has one, is that we've got more to do than we may realize. But we have made encouraging progress, and if all our efforts to attain peace and to progress in human affairs were of the caliber of the research conducted by you of the Forest Products Laboratory on the utilization of one of our most prized resources, we would have little to fear."

The changing picture in the utilization of wood, due largely to economic forces and to the competition of other materials, was emphasized by all of the speakers. Frederick K. Weyerhaeuser, chairman of the board of the Weyerhaeuser Company, pointed out that while lumber has been losing markets since 1909 other wood products, such as pulp and paper and plywood, have largely made up for lumber's loss. "The overall result has been an increased demand for trees and such an increase in their market value that private industry can earn a small return from its tree-growing operations."

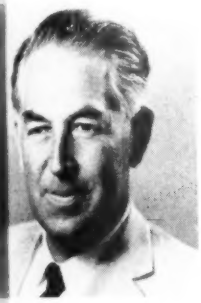
Great stress was laid on the phenomenal development of the pulp and paper industry and on the contribution of the Forest Products Laboratory to that development. The semi-chemical process of pulping and the cold soda process, both developed by the Forest Products Laboratory, have revolutionized the industry by making new species available and by reducing losses in manufacture. Stanton W. Mead, president of the Consolidated Water Power and Paper Company, stated that "we now have sufficient understanding in pulping processes to make it possible to derive refined wood pulp from any species of tree which Nature provides." He then illustrated what this fact means in human as well as economic terms. Before the semi-chemical process made possible the utilization of such hardwoods as oak, ash, elm, maple, birch, and poplar his company had to obtain 95 per cent of its pulpwood from remote areas via rail shipments.

Governor Gaylord Nelson, Wisconsin

C. A. Elvehjem, president, the University of Wisconsin

Franz F. P. Kollmann, professor, University of Munich

Richard E. McArdle, chief, United States Forest Service



Ervin L. Peterson, Asst. Sec. of Agri.

These distinguished leaders of industry, government, and education attended the Forest Products Laboratory's golden anniversary celebration to pay tribute to that institution's outstanding accomplishments.

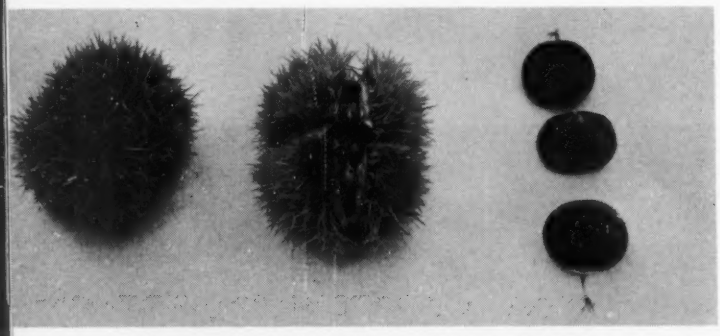
"Now we are buying about 25,000 cords annually from local producers within a 50-mile radius, and this wood is delivered by truck. It gives farmers and other rural residents gainful employment in winter, which is normally the quiet season for farmers. Last winter we bought 20,000 cords by truck delivery and paid the producers $620,000 for their pulpwood. Thus our adoption of this new pulping technique has benefitted society as a whole as well as our company."

Howard E. Whitaker, chairman of the board of the Mead Corporation and president of the American Paper and Pulp Association, introduced a bit of wry humor into his speech. After pointing out that the variety of its forms and the number of uses to which we put paper is endless, he commented that the rate of use of paper has often been referred to as an index of the degree of civilization. "Perhaps it is. I don't know.

(*Turn to page* 90)

Flaming gas jets vividly showed golden anniversary visitors how the Forest Products Laboratory tests wood structures for fire resistance

Chestnut tree No. 22, 10 years old, has been best bearing tree. At the beginning of summer it looks barren, but by fall it is loaded with burs

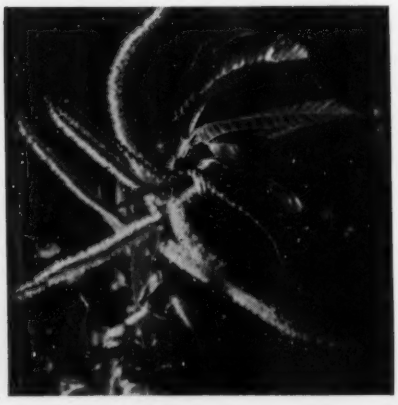


A bur usually yields a cluster of three chestnuts, although a cluster of five or seven chestnuts is not an uncommon occurrence

THE CHESTNUT CHALLENGE

By BERNARD D. ROSS

The very fuzzy catkins are male and the ones that do not seem to open are female



After sorting the nuts, the Horvaths had five pecks of large seed nuts, fine for propagating new trees, and four bushels of small ones

Frank Horvath inspects an apple tree that is almost lying on the ground. Possibly it could be straightened, but that will take years to complete.

Julie forgot to put wire mesh over the seed bed and animals ate all the nuts

ONCE a billion American chestnut trees covered the land. Recently the U. S. Department of Agriculture reported only 38. Many adults still remember how as children they used to race to the chestnut trees in early morning to fill their pockets with nuts before the fallen burs could be emptied by wildlife.

Chestnuts are an American family tradition. No Christmas dinner was complete without the chestnut stuffing. The trees used to serve as forage stations for turkey, deer, and other wildlife. Chestnut beams and rails made log cabins and fences and bridges, and the tannin of the bark cured leather. Roasted chestnuts, peeled down with some difficulty to the sweet tender substance of the red-brown nut, spelled the spirit of many a gathering on a cold winter night.

Then came the blight. Fungus *Endothia parasitica,* believed to be carried over from China, was discovered in New York City in 1904. It swept the country, killing all chestnut stands in its path, searing the trunks of trees as if by fire to leave them standing dying or dead. New generations of Americans grew up to know chestnuts only in connection with Longfellow's village smithy, from pop songs, or from the counters of food markets that import from Italy or Portugal.

In the midst of this scarcity, the Frank J. Horvath family of Cleveland Heights, Ohio, has 460 thriving, blightproof Chinese chestnut trees on their 42-acre farm in Middlefield, 35 miles from their home.

The farm is an experimental project, returning little revenue. To chemical engineer Frank and his science-teacher wife, Julie, saddled 14 years ago with a farm that needed a money crop, the idea of planting trees posed a practical challenge.

As Frank tells it, "Although the farm was owned by Julie's family, it was left untenanted for four years during World War II. It degenerated terribly and was ridden with rats and snakes—it was a mess. When Cecie was born 14 years ago, I had to take the farm seriously since I was paying the taxes."

He started by renovating the house to make it livable. He wired it, installed a septic tank, repaired the chimney, and ratproofed the inside with a rocklike mixture of sand and cement. While trying to decide if the house was worth salvaging or

Frank drives the tractor while Julie, Cecelia, and Arthur ride in the buckboard. They consider this form of transportation somewhat elegant.

should be torn down, he discovered the interior was constructed entirely of walnut, and the framing and siding were made out of beech and maple so hard he couldn't drive a nail into it. Hand-made square nails held the boards together. Frank put new laths inside the house, covered them with dry plaster, and sealed the walls. Then he painted the house inside and out.

In the years following World War II, Frank often took walks around the farm, trying to decide what could be done to make it pay. As a professional engineer, he sought a development which would be practical, yet new; one that would lend pride and enjoyment in later years. He studied the soil and made mental note of the places where it was completely exhausted and would not even grow weeds. He wondered whether to put in trees or a cover crop. If he put in a cover crop, who would harvest it? Deciding to have tenants on an equal-share basis, he tried this temporarily, but found to his regret that it provided very little return for his family.

Then he started buying trees, rather slowly at first, aided by his father-in-law who took pleasure in planting them and seeing the farm assume new vitality. Later on Frank increased the quantities from 50 nut and fruit trees at a time to 100, and 500 spruce and pine trees at a time to 1000, and then he bought more.

Fond of chestnuts since boyhood, Frank often thought of planting chestnut trees, but hesitated largely because of a reply he had received from the government saying they did not recommend starting any large plantation of chestnuts. Because the peanut was so popular, they wrote, they could not be sure the chestnut would once again win public acceptance; if it did, it might take some time to accustom new generations to the favorite of the past.

Frank continued to write to the U. S. Department of Agriculture for all information about the new Chinese chestnuts being propagated by them and also sent inquiries to individual growers. At that time, chestnuts were rarely seen in this country. The Department of Agriculture was importing seeds from different countries to see if they could introduce a strain which would not succumb to the blight. In China, some trees had managed to resist it, and these were among strains the government was trying to establish here.

Frank's neighbors felt some reservations about his planned undertaking. One advised it was foolish to plant something for which he would have to wait six years, or possibly even ten, to realize his first returns. This framed Frank's puzzle—how to work it so that they could obtain some returns from the land and at the same time be able to raise chestnuts.

One grower to whom he addressed an inquiry was the owner of a farm in Pennsylvania, who had written an article stating that if he were younger, he would plant alternate peach and chestnut trees—peaches for relatively quick results, and chestnuts for long-range yield. When Frank read this in 1948, he knew it was the answer.

To start growing chestnut trees, the Horvaths ordered five pounds of chestnut seeds of an unidentified Chinese variety from a nursery in Pennsylvania. From these they got only 39 trees, which was a poor yield. The trees were small, and they left them in the seed bed. They were ready to quit then, but Frank kept writing to the government experts at the Beltsville, Maryland Experiment Station, who finally advised him to try. They recommended purchasing seed nuts from Leeland Farm in Leesburg, Georgia.

Frank then ordered 25 pounds of seed nuts. The Horvaths planted the nuts in the seed beds and, next year, obtained an excellent yield.

Locating the trees and planting them involved exhaustive efforts. In late fall, Frank had had an area plowed which he thought was about eight acres and would support about 500 peach trees and the 500 chestnut trees they had in the seed bed. Hampered first by frozen ground and months later by all-day rain, the farmer never succeeded in disking the land.

Months passed into a rainy and snowy April. Julie vows she never before saw such miserable planting weather. Then, earlier than expected, the peach trees arrived. Julie's brother and a friend came to help them. For this planting, Frank had bought what Julie describes as two "lovely" 10-foot boards that they marked off at 1-foot intervals.

Just after they had finished planting the chestnut orchard up the hill, a number of the trees had swellings in the trunk about an inch or two inches above the ground level. Thinking this odd, Julie clipped a couple off, sacrificed to the cause of science, packed them in a box, and shipped them off to the Ohio State Experiment Station. The reply that it was probably the blight completely devastated the Horvaths' hopes. But they thought, "We'll just let them live and see what comes." In the meantime, their letter and samples had been forwarded to the entomological department of the experiment station, and the chief entomologist wrote to them that it looked like the sting of an insect and had a gall-like aspect.

Later in the summer they put wires around all of the trees to protect them from animals. They bought rolls of chicken wire 1½ feet high. Julie cut them, personally, with a wire cutter—1170 sections of wire mesh. Everyone pitched in and helped to put them around all of the trees.

That summer they used a truck to

(*Turn to page* 95)

"HOWDY" STAMPS GO ON SALE

Want to spread the "good outdoor manners" gospel far and wide? If so, your answer is "Howdy" stamps as sponsored by the Pennsylvania Forestry Association. "Howdy," of course, is the "good outdoor manners raccoon," and last month "Howdy" stamps with their conservation message were placed on sale for the first time.

The "Howdy" sheet of stamps contains 30 "good manners" messages that can be stuck on letters and other mailing materials. They sell for 25 cents per sheet or 40 sheets for $5.00, 100 sheets for $10. Already 50,000 stamps are being distributed by Boy and Girl Scouts, women's clubs, industries, and conservation organizations.

Your order for "Howdy" stamps should be mailed to the Pennsylvania Forestry Association, P. O. Box 389, Ardmore, Pennsylvania.

PESTS, PESTICIDES, AND PEOPLE

by

ALBERT C. WORRELL

School of Forestry, Yale University

■

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PESTS, PESTICIDES AND PEOPLE

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Professor Worrell received his forestry education at Pennsylvania State College and the University of Michigan. He was awarded a Ph.D. degree in forest economics from Michigan in 1953. He is the author of "Economics of American Forestry."

At the present time, Professor Worrell is on leave of absence from Yale to serve as principal economist for the Economic Commission for Latin America on a study of timber trends and prospects in that area.

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The Worrell Essay in Brief

Dr. Worrell's essay is an explanatory one in the best sense, and deals not with technical features of pesticide use, but with broad social factors which should enter into policies for pesticide use. Since chemical pesticides are not cheap, since, in fact, the control of insects and other pests now calls for large expenditures by owners and operators of crop and forest lands and by government, and also since pesticides can have detrimental effects on the environment, it is clearly vital that the costs and benefits of such use be carefully compared in a systematic way.

Pests are controlled not only to protect crop lands and forests but also for reasons of health, comfort, recreation opportunity, and the appearance and biological stability of the landscape. For the sake of these benefits, costs of control work and other consequences of pesticide use are borne. Since much control work is done by government agencies delegated to secure one or more of the benefits mentioned, control programs need to be guided by the fullest possible information about their consequences upon various interests and society at large.

This work of evaluation is not easy to carry out—not only because of incomplete data as to physical and biological consequences of many pesticide practices, but also because the interests of particular individuals and of the various groups in society affected by pest control are not identical.

Dr. Worrell sets forth some tentative criteria for judging the merits of control programs in their broadest sense and includes the notion of the public interest as a useful guide. He presents by way of example the revealing history of the 70-year campaign against the gypsy moth in the Northeast, and tests the suggested criteria in the light of this history.

Dr. Worrell also describes the considerable number of government agencies and other groups concerned with different steps in the whole business of pest control by society, such as research, pesticide testing, regulation of use, educational work, manufacture, and application. The point of this part of his essay is to show that there are many influences which come to bear on the actual use of pesticides, from diagnosis of pest problems to prescription of specific chemicals and methods of application. A key question, of course, is whether present arrangements in this country are adequate for guiding pesticide use in the light of good information regarding total costs and benefits.

Dr. Worrell concludes in noting how difficult it is to judge "composite" situations of pesticide use where many different chemicals are being applied year after year in particular areas. Such evaluation is also hampered by serious deficiencies of knowledge regarding the physical and biological effects of pesticides. Only from such knowledge can adequate comparisons of costs and benefits of control work come in the future.

INTRODUCTION

THERE has been much public discussion and controversy in recent years over the methods used to control insects, fungi, rodents, and other pests. This increased interest and concern has stemmed from the speed with which these pest control activities have expanded and the rate at which they continue to extend to larger areas each year. Increased interest has led in turn to an awareness of the highly toxic nature of the materials being used and the hazards which these pesticides may represent to man and animals.

Unfortunately, many of the people who recognize these potential hazards have been uncritically vehement in their attacks on pesticide use. Some apparently have felt that the danger justified any tactics and have resorted to inflammatory public statements and writings of questionable factual content. Pest control workers have considered this campaign a threat—or at least a hindrance—to the performance of control activities which they felt were imperative. So proponents of the use of pesticides have joined the controversy, sometimes with statements as questionable as those of their opponents. Under such conditions it is difficult to know who or what to believe, and people who should be taking an informed stand on this issue find themselves confused and swayed by prejudice and emotion.

This study attempts to cut through the smokescreen of charge and countercharge to the real issues and to provide a basis for intelligent consideration of the problems posed by widespread pesticide use. The most heated controversies have developed over insect control activities, and particularly over the spraying of extensive areas with insecticides from airplanes. The main focus of this report will be on these aerial spraying programs with emphasis on forest insects. But the ideas developed should be generally useful since the basic problems appear to be similar in any pesticide use.

INSECTS AS PESTS

Tremendous numbers of insects inhabit this earth and many of them live in close proximity with people. Most insects do not affect people at all or are beneficial to them; some have detrimental effects, and the total numbers of such species may be very large.

Some insects attack people directly, and some carry diseases or other pests. Others do little physical damage but cause considerable discomfort and annoyance. Some insects damage or destroy man's physical wealth —directly damage property which he otherwise could use or consume. Others interfere with productive activities so that the final output is reduced in quantity or quality.

The effect of these insects on human welfare depends largely on the number that are present. Small numbers of most insects go unnoticed or are tolerated even though they do some damage. Larger numbers do enough damage to be intolerable, and attempts at control are necessary.

The reproductive potential of most insects is very large compared to that of most other animals. Some species have such a short life span that many successive generations may be born, grow, reproduce, and die within a single year. A pair of such insects is potentially capable of having millions of descendants in the course of a summer. These numbers are only potential, but under favorable circumstances insect populations can build up rapidly to numbers which people find intolerable.

The populations of some insects remain reasonably stable in size, though these populations may be large enough to be continuously intolerable to people. But many insect populations fluctuate in size, and sometimes the fluctuations are violent. A species of insect may ordinarily occur in such small numbers as to be unnoticed or easily ignored by people. Then some combination of favorable circumstances permits this species to come nearer than usual to realizing its high reproductive potential. The population increases to epidemic proportions, and an ordinarily unimportant insect becomes a pest.

Some of our important insect pests have been introduced from other countries. When such exotic insects find the local conditions suitable, they establish themselves and spread. Once they are firmly established, these invaders act like native insects except that they may continue to extend their distribution. Such insects may find conditions very favorable in their new location and may increase in numbers quite rapidly. But the facility with which they spread and the extent to which their populations fluctuate in size depend more on the specific characteristics of the insect than on the fact that they are exotics.

Insect pests have increased in importance as a problem. The changes which man has made in the environment through his practice of agriculture and forestry has often produced conditions more favorable for insects. Pests have been transported into new areas with a resulting increase in the number of pests species locally; at the same time, man has become less tolerant of insects and the damage they do. People are more and more insistent on blemish-free produce and the elimination of annoying insects from their surroundings as our standard of living improves.

CONTROL OF INSECT PESTS

The total number of insects is held in check by various natural factors. Among these are climatic and weather conditions such as extreme cold, heavy rains, and drought; many kinds of diseases, parasites and predators, and starvation.

A particular insect may arrive at a balance with its food supply, the local climatic conditions, and the mortality caused by diseases, parasites, and predators. The population may remain fairly stable with these factors killing enough individuals to keep reproduction well below the potential. But this stable population may still be large enough to do more damage than people will tolerate.

Some insects periodically experience large fluctuations in population numbers. Such epidemic increases may follow a relaxation of natural controls due to favorable weather, especially abundant food, or reduced effectiveness of parasites, predators, and diseases. Or they may be an expression of increased vigor due to hybridization. In any event, the existing natural controls are not sufficient to hold down reproduction, and an epidemic population develops. The parasites, predators, and diseases gradually catch up with the insect and reduce the population. Weather which is unfavorable for the insect but favorable for its enemies may speed up this process. Or before these factors are able to come fully into play, the insect may destroy its food supply and starvation may bring the epidemic to an end. Thus an insect epidemic eventually will be terminated by natural factors, and the population will fall back to its previous level. But the time required for these natural factors to accomplish this may be long enough that the insect does a great deal of damage in the meantime.

The control factors naturally present in the environment are not sufficient to keep insects always below intolerable numbers. Man, therefore, seeks additional means of reducing harmful insect populations.

One approach is to increase or strengthen the natural control factors. Climate and weather are generally beyond human control at the present time. But attempts may be made to introduce new parasites, predators, and diseases to the area. It may be possible to transfer some of the exotic's old enemies and to establish them in the new area where their natural prey has settled. Diseases, parasites, and predators which attack similar insects in other places may also be brought in with some success.

Introduced natural enemies have sometimes been effective in reducing insect populations. But these natural factors have two serious weaknesses in pest control besides the technical difficulties involved in discovering, collecting, rearing, and disseminating them. Probably no natural factor is capable of completely exterminating the kind of insect it attacks. Its general effect is to kill more of the insects than would have died anyway from other causes and thus to lower the total population. The remaining population may still be larger than will be tolerated.

The second weakness is that in epidemic situations the natural factors are too slow in exerting their control. They may bring the epidemic to an end eventually and may even reduce the residual population to numbers that people can ignore. But between the time that an epidemic reaches serious proportions and the time that natural factors bring about its collapse, an insect pest may have killed hundreds of thousands of acres of valuable timber.

The other ways of dealing with insect pests also have weaknesses. Direct controls—such as cutting and burning infested trees—may be successful with certain insects. These methods are very expensive and are almost impossible to use on extensive outbreaks. They may require the destruction of a considerable part of the crop in order to save the rest from insect damage.

Cultural methods are useful in controlling some insects. These aim at adjusting the environment to make it unfavorable for the insect or else more favorable for the pest's victims. Manipulation of water levels to prevent the breeding of mosquitoes is an example. The development through controlled breeding of strains of plants which are resistant to attack by certain insects has been successful in some cases and holds considerable promise. As with the natural factors, cultural techniques and genetic development are only limited means of insect control. They may reduce the damage but probably cannot eliminate it. In epidemic or invasion situations, cultural controls are too slow. They are only effective if they have been applied before an outbreak begins to develop.

CHEMICAL PESTICIDES

The techniques mentioned usually are unable to hold a total pest population to a tolerable level or lack the speed of action needed to cope with epidemic situations. Even if all these other techniques are applied, the pest may still survive in intolerable numbers. The only present answer to this problem then appears to be the use of chemical pesticides.

These chemicals kill directly and usually quickly. If applied during the most susceptible stage of the insect's development, they can reduce the population drastically. Some insects appear to have been eradicated from sizable areas by chemical pesticides. If

the pesticide is applied early in the stage when the insect is most destructive, the pest may be killed before it has a chance to do much damage. Widespread infestations can be treated by spraying the chemicals from airplanes. (This is strictly true only of defoliating insects and others which live in exposed places. But most insects must appear in the open at some stage in their development.) Chemical pesticides are an effective weapon for controlling insect pests rapidly.

Chemical control may be used with three different objectives, which will influence the choice of the chemical used, the amount which is applied, the form and method of the application, the timing of the application, and will affect the complications which may develop.

The first such objective may be to eradicate an insect from some particular area. None of the other control methods appears capable of killing every single insect, but the application of chemical pesticides apparently has exterminated some insects in some places. If it is successful, the chemical application does not have to be repeated.

The second such objective is to suppress an epidemic population by drastic reduction. One or two applications of the chemical may accomplish this, and further use will be unnecessary until another epidemic situation develops.

The third such objective is to reduce the population of an insect which regularly exists in numbers that man will not tolerate. Since the insect population is naturally too large to be tolerable, natural controls are inadequate, and chemical control effects only temporary reduction in numbers. Application of the pesticide then must be repeated regularly at sufficient intervals to hold the population at the desired level.

THE COSTS OF CHEMICAL CONTROL

Chemical pesticides differ from the other insect-control agents in the kind of costs involved. In any attempt to control insects, labor and other resources must be used which might have been put to other purposes. These direct costs may be lower for chemical pesticides, but their use also involves some indirect costs which do not show up when other methods are employed.

Chemical pesticides are poisons and toxic in some measure to other forms of life as well as to insects. In the process of killing the insect pest, other organisms may also be killed or at least seriously harmed. The effect which any chemical has on an organism depends on the amount to which that organism is exposed. A large enough dose of any pesticide in common use will kill animals and even man. But so will a large enough dose of common table salt. Our regular diet includes minute quantities of a number of chemicals that would be deadly in larger amounts. Organisms vary in their reactions to the pesticides, and susceptibility varies with size, age, and other characteristics.

The immediate killing potency of a pesticide may not be a good indication of the seriousness of its side effects. Some chemicals accumulate in animal tissues and may build up to lethal amounts. Exposure to pesticides may not kill an animal but may weaken it or damage it so that it is more susceptible to diseases or in other ways less capable of surviving. Pesticides may affect the reproductive capacity of an animal so that it either is sterile or produces inferior offspring. Effects will vary with the amount of the chemical to which the animal is exposed.

Interrelations between chemicals and organisms are clearly complex. This is part of the reason for some of the conflicting views as to the side effects of pesticides.

EFFECT ON OTHER INSECTS

Any area in which a noxious insect is present will almost certainly contain numerous other kinds of insects. Some of these may also be noxious, some may be neutral as far as man is concerned, and some may be beneficial to man. It might seem that all of these would be killed by a pesticide application, but several things prevent this. Insects pass through a number of stages in their lifetime. An insect may be well protected from the poison in some of these stages, such as the egg or the pupa. Part of many insects' lives are passed in sheltered places where the chemical spray cannot reach them. And not all insects are in the same stage of development at the same time. When one species of caterpillar is in its most exposed stage, other insects will be in the egg, or in the pupal stage, or in some sheltered position. A pesticide which retains its toxicity for only a short time after application will kill only those insects which are exposed at the time it is applied.

Because of their high reproductive potential, most species of insects apparently can regain their former population size in a relatively short time after decimation by a pesticide. Some species recover slowly, but reduction in the total insect population caused by a pesticide application appears to be temporary. If some species are exterminated, their place in the population may be filled by larger numbers of other species.

It is possible that a pesticide application may kill enough of the parasites and predators of some other insect to permit that insect to increase to pest proportions. This result has seldom occurred and appears to be susceptible to other means of control if it does.

EFFECT ON FISH

Most insecticides are highly toxic to fish and other aquatic life. However, there is considerable variation in susceptibility here too, and in general the larger the fish the less susceptible it is. Other conditions such as the rate of flow of the stream and the turbulence of the water also influence the amount of mortality that occurs. Any pesticide chemical that is washed from the foliage and carried to streams and lakes in runoff is concentrated into much larger amounts per unit of area than the rate at which it was originally applied. So the hazard to fish may increase with the size of the area that is sprayed.

Fish may also be affected indirectly through the effect of the pesticide on other aquatic animals. If these animals are killed or incapacitated by the chemical, they may be eaten by a fish in large quantities. The fish then receives a more concentrated dose of the poison than it could get directly from the water. Many animals eat other animals and then in turn are eaten themselves. In such a "food chain" each successive consumer would receive a larger dose of the poison. An application of pesticide which was not lethal to the simple organisms far down in the chain might be concentrated by successive food organisms to amounts that are lethal to higher animals.

The deaths of a large proportion of the minor aquatic life from pesticide poisoning might provide an immediate banquet for the fish but be followed by a period of near starvation. However, the insect populations rebuild rapidly – especially in flowing streams which are not completely treated – and there is little evidence of any extensive starvation of fish as a result of pesticide treatments.

EFFECT ON BIRDS AND MAMMALS

Most insecticides are less toxic to birds and mammals than they are to insects and fish. Some of them, however, are more lethal to these forms of life than are others. And different species of animals vary in their reactions to individual pesticides. The effect also varies with the age and size of the animal and with the form in which the pesticide is applied. In general, the significant factor is the amount of the chemical to which the animal is exposed. The amount of pesticide required to control an insect in many cases appears to be too small to have any direct effect on birds and mammals.

There is a possibility that an effective insect control program might eliminate much of the food supply of insectivorous birds and mammals. Since most of these animals can travel considerable distances, they would not suffer a serious lack of food unless the insects were killed over a very large area, or territorial behavior prevented movement. And the total insect population builds back up rapidly after treatment.

The food chain effect may be more serious. Robins are reported to have been killed by eating earthworms that had absorbed DDT from the ground below trees sprayed for insect control. Some pesticides are fairly stable. They do not break down quickly after application but remain toxic for long periods. Animals may gradually absorb them—either directly or through food organisms—and the chemical may accumulate in their bodies until it reaches a lethal amount. Migratory birds, such as ducks, may be exposed to pesticides at many stops along their routes and might eventually accumulate enough chemical to kill them. But all of the chemical which an animal absorbs does not necessarily accumulate in its body. Some may be broken down within the body into other forms that may not be toxic. And there probably is a limit to the amount stored, after which additional amounts are excreted. Knowledge of the physiological relationships is still quite weak.

Studies at the Patuxent Research Refuge indicate that the reproductive capacity is affected in quail and pheasants whose diet continuously includes certain amounts of DDT or other pesticides. The effect appears in breeding success, in the number of eggs hatching, and in the proportion of cripples among the young. (This has not as yet been demonstrated with other animals.) Here, as in the killing effect, the amount of the poison to which the bird is exposed is a significant factor. It is not known whether the natural foods that a bird eats in the wild could become contaminated enough that its regular diet would contain a damaging amount of chemical. And it may be questioned whether the amounts applied to control insects are large enough to supply this necessary amount in the diet.

EFFECT ON MEN

Most of what has been said about the effects of chemical pesticides on animals can be extended to man. Some chemicals are clearly more toxic to man than others, and any of them would be lethal in large enough amounts. People probably vary in their reactions to these chemicals, so that some individuals may be affected by exposure to amounts that would be ignored by others. Because of their size, humans in general are probably less susceptible to harm from the usual insecticide application than are birds and small mammals.

The reported cases of pesticide poisoning in humans result from concentrated exposure. Careless applicators and children playing with opened pesticide containers are the common examples. So long as people take reasonable precautions, they apparently can stand considerable exposure to pesticides without harm.

There is a problem of continued exposure. Tests show, for example, that a large part of our food contains detectable amounts of DDT. Because of man's relatively long life span he has time to accumulate a considerable amount of poison from a daily diet which contains only traces of pesticides. There is no evidence that people can accumulate dangerous amounts of poison from their present exposure. But because of the limitations on scientific testing of the effects of pesticides on human beings, present knowledge of the possible effects is quite limited.

EFFECT ON PLANTS

Effective insecticides are likely to be lethal to plants as well as to animals. But the amounts required to affect plants are apparently very large compared to the amounts used in insect control. The possible

danger seems to lie in an accumulation of chemicals in the soil from repeated treatments until the amount built up becomes sufficient to affect the vegetation. Most of the common insecticides break down fairly soon after application, so insecticides would not appear to be a threat to plants except where applications are repeated at short intervals.

STABILITY OF EXISTENCE

Under natural conditions animals and plants exist in reasonably well-adjusted associations which are adapted to their physiographic and climatic environment. These are not absolutely stable associations but ones in which continuous adjustments and readjustments are in process. The so-called "balance of nature" probably more nearly resembles a successful juggling act than it does a perfectly adjusted analytical balance. The interplay of the numerous animals and plants is exceedingly complex. Each individual is influenced by its total environment and at the same time influences that environment. This is true of the physical as well as the biological components of the environment. Because of this complex interrelationship anything which changes one component of the environment will probably at the same time (or eventually) change other components. Any given change may set in motion a whole chain of reactions.

Mankind is a part of this natural association. The human race has formed habits and developed social patterns which enable it to lead a fairly stable existence in its complex environment. At the same time it has tried to manipulate some components of that environment in its own favor. This manipulation has taken two general forms: changing some parts of the environment in order to make it possible or easier for man to live the way he wants to, and eliminating or modifying some parts of the environment which have a direct detrimental effect on man. The further man goes in manipulating his environment the more these two forms run together. For example, men have changed the natural landscape into clean-tilled agricultural fields in order to get food more easily. But this monoculture has favored certain insects which increase and destroy the plants. Men have then tried to eliminate the insects as a means of preventing their detrimental effects on the human food supply.

The process of human civilization has been one of gradually modifying the environment to make it more favorable to man. As a result of this process we now live in an environment which, if it cannot be called "artificial," is at least largely dependent for its continued existence on the maintenance efforts of men. Our economic and social systems form a significant part of the environment in which modern man lives. If people are to lead a reasonably stable existence, therefore, drastic changes in man's total environment —including its natural components and its societal (or artificial) components—must be avoided.

The stability of man's environment is significant in any consideration of pest control. Both the pests themselves and the actions taken to control them should be evaluated in terms of their effect on the total environment. The immediate effects in either case may be less important than the sum total of the chain of effects which they initiate.

For example, the depredations of an insect pest may cause it to become economically impossible to grow a major crop in some area or may destroy the raw material source of a wood-using industry. In this case the value of the crop or trees directly destroyed would be only a small part of the loss to man. Much more important would be the disruption of the economic life of the communities affected, the enforced migration of people, and the necessary abandonment or liquidation of what otherwise would have been permanent capital resources.

The effects of pest control on the environment may be more subtle but none the less real. The direct side effects of a pesticide application may be only a part of its total effect. For example, suppose that a chemical used to control a noxious insect also killed many other insects and left sufficient residues to affect the bird and mammal population. The total number of resident animals might be reduced, their vigor might be affected, and the proportions of different species in the total population might be changed. These changes might lead to differences in the amounts and kinds of insects, weed seeds, plants, and other foods consumed by the resident animals. This in turn could lead to increased economic damage by different insects and animals, more prolific seeding by weeds, etc. In an extreme case, the result might be a major change in the environment with unpredictable effects on man. Probably such extreme changes are not likely to happen or else would be recognized and offset before they progressed so far. But pest control actions have at least a potential of initiating complex changes in the total environment.

A PROBLEM OF CHOICE

Insect control presents a two-sided problem. On the one hand are the noxious insects which destroy property, interfere with production, menace health, and keep people from being comfortable. Man's general standard of living and overall satisfaction with life might be increased if these insects were reduced or eliminated. On the other hand are the procedures required to reduce or eliminate the insects. These

are expensive in terms of the labor and other resources which they use and also in terms of the damage to other forms of life that accompany their use. The benefits of insect control can be obtained only by incurring the costs. How can a balance be struck to ensure that the costs of this effort will not exceed the benefits?

An approach to this problem can be demonstrated in a very simple situation for which there is a theoretically correct solution. Assume that there is only one insect pest, that it is not possible to eradicate this pest, and that all of the costs and benefits of controlling it can be measured perfectly in some common unit of value. The population of this pest can be held down in numbers by the use of pesticides or other techniques. The smaller the population, the less damage the pest will do but also the greater the cost of holding the population down to that level. It is rational to reduce the population of this pest so long as the cost of killing part of the insects is less than the damage done if they were not killed. If the control effort continues to increase and the population is thus reduced, a point will eventually be reached where the damage that would be prevented by killing more insects is less than it would cost to kill them. Under the circumstances, this is the tolerable population of this pest. Any population larger than this is intolerable because the additional insects can be killed for less than the equivalent of the damage they are doing. Theoretically, pest control would make its greatest contribution to human welfare when sufficient work is done to hold the insect population just at the tolerable limit.

Before such a cost-benefit approach can be undertaken, it is necessary to have a clear understanding of the costs and benefits that are involved in pest control. The real benefits and, particularly, the real costs are often obscured by talking about them in terms of dollars. To be useful an assessment must be made in terms of more basic objectives.

GOALS OF HUMAN ACTION

The activities of individuals and societies are oriented toward various fundamental objectives which they would like to achieve. These basic goals are numerous and complex but only some of them appear to be relevant to the pesticide problem. They may be postulated as: material goods and services, health, comfort, leisure, aesthetic satisfaction, opportunity for recreation, and stability of existence.

Pest control and the use of pesticides must be considered in relation to these basic goals. An insect or other organism becomes a pest when it seriously interferes with the achievement of some of these goals. Control of the pest may therefore be a means of progressing toward the desired objectives. Pest control is not an ultimate end in itself but is only a means toward some more basic goal. The benefits of pest control will appear in the form of more material goods and services, better health, more leisure time, or some other fundamental goal. (If a pest threatens to reduce man's present status in these respects, the benefit may take the form of a loss prevented rather than a gain obtained.)

Pest control involves costs as well as benefits. The real costs are the values of the things that must be sacrificed in order to obtain the things desired. These costs are not necessarily goods and services—they may represent sacrifices in health, comfort, leisure, or any other goal. The costs of pest control can be expressed in terms of effects on the same basic goals as the benefits.

Any pest control effort will produce benefits and involve costs in terms of the postulated goals. The benefits may represent gains toward some goals while the costs are sacrifices in terms of other goals. Or the same goals may be affected on both the benefit and the cost side. In any event, a pest control action will involve some conflict. The problem in evaluating pest control lies in determining whether the total result will be a net gain or loss in terms of all of the relevant fundamental goals.

COMPARING COSTS AND BENEFITS

In the simple example given earlier, the analysis showed that additional insect control should be undertaken if its benefits would exceed its costs. When both benefits and costs are expressed in terms of basic human goals, this comparison ceases to be a simple one. There is no common value unit—such as dollars —in which all of the significant costs and benefits can be measured. What is the value of the benefit that an individual receives from the elm trees in his yard? And what is the value of the robins which might be killed by the spraying required to save those trees from the Dutch elm disease? Individuals are able to rank things according to their own personal preference and to say that one is more valuable to them than another. So an individual, presumably, could make a choice between trees and birds which he would feel was satisfactory.

But most of the choices will not involve such a straightforward comparison of cost and benefit. The choice will usually be between a bundle of benefits and a bundle of costs. Take a spraying program to control the spruce budworm, for example. The benefits might consist of the standing timber saved for future raw material for local industry, the tree cover saved on areas of recreational and aesthetic value, and the prevention of forest fires (which would be almost inevitable in a budworm-killed forest) with their consequent detrimental effects on streamflow and wild-

life. There would be still other benefits. The costs might consist of the money which the public and consumers would have to part with through taxes and higher prices, the fish killed in the local streams and the consequent reduction in sport fishing success and commercial fishing activities, and the contamination of water supplies drawn from this area. There might be still other costs.

Individuals apparently can rank such bundles according to their own personal preferences and can say that they would be willing to give up one bundle in order to have the other. But they can do this rationally only if they know the composition of each bundle. Information must be available to them about the facts on both sides of the choice. Unfortunately, the facts are not known with certainty about many of the costs and benefits of pest control actions. Various things are known with varying degrees of probability that the knowledge may be correct. Some things are known only as possibilities, and present evidence is not sufficient to confirm or deny them as facts. So the bundles of benefits and costs often include some uncertain items, and in such cases the total benefit or cost is also uncertain.

An individual facing such a choice will seldom have all of the facts at his conscious command. People tend to be apathetic about things which do not clearly affect them in a personal way and are therefore unaware of much existing information. Most people do not have sufficient specialized education and knowledge to appreciate and understand the ecological and physiological effects of extensive pesticide applications. Even if they were given the technical information, or had sufficient interest to seek it out, they would not be equipped to understand it completely. And in addition, our present economic structure is so vast and complex that no individual ever personally sees the workings of more than a small part of it. It is therefore usually beyond his power to visualize all the ramifications of the effects and counter-effects which any particular action might initiate in the economy.

Even if the facts were perfectly known, a further difficulty would exist because many different people will ordinarily be involved in any pest control undertaking. The costs and benefits of such an undertaking will seldom be divided equally among all these people. Some of the costs may be borne by people who have not been suffering any damage from the insect and who will not benefit from its control. And some of the benefits may be received by people who do not feel any of the costs. A noxious insect always does more damage to some people than it does to others. So some people as individuals would choose to undertake the control program and others would choose to tolerate the pest rather than incur the control costs.

Even if the costs and benefits were equally divided among the many people involved, there is still the problem that people do not necessarily place the same values on the same things. They may not even rank them in the same order of preference. One person may value song birds highly while his neighbor, who grows small fruit, may consider the same birds to be a nuisance. A pest-control program which killed some song birds would represent a cost to the bird lover but no cost and perhaps even a benefit to his fruit-growing neighbor.

The typical pest-control decision is not one that can be made by a single individual comparing the costs and benefits to himself. The costs to a number of people must be compared with the benefits to a number of people. But there are no common units in which all of these costs and benefits can be measured. So an objective summation of all of the individual costs and benefits in comparable totals is not possible. And even a subjective comparison—such as an individual can make in some circumstance which concerns only him—is not strictly possible because of the different judgments of value by the different individuals concerned.

THE PUBLIC INTEREST

The previous section indicates that deciding whether the benefits of a pest control program will exceed its costs (when both are measured in terms of the relevant human goals) is no simple task. But is cost and benefit analysis therefore useless in the making of pest control decisions? I do not think so.

A major stumbling block in judging the desirability of a particular pest control action is the conflicting interests of the people who are concerned. Individual desires must be compromised with those of the other members of the society. But what is to guide the compromises that are made?

The need here is for some idea of what would be "good" for society as a whole. This involves a concept of a public interest as contrasted with the private or individual interests of the members of the society. The public interest implies consideration both of the public as a social unit and of the specific individuals who make up that public. Any action that is detrimental to the welfare of the social unit or of all of its members is not in the public interest. Nor are actions that damage some members of the group more than they benefit some members.

The public interest in pest control takes both of these forms. In some respects the "public" as a social unit has goals or objectives that are not necessarily the same as those held by individuals. The public interest, in this sense, may involve such things as the survival of the group, the general level of physical and mental health, and the social and environmental sta-

bility of the group. In other respects the "public" is a collection of individuals. For an action to be in the public interest it must be consistent with as large a part of the individual interests as is possible.

Clearly, the public interest in pest control is not a simple thing to determine. We can make a start, however, by recognizing that in order to understand part of the public interest in pest control the "public" must be viewed as a unit. The social unit has an interest, for example, in public health. This is a unitary interest that goes beyond a summation of the interests of the individual members of the society in their own personal health. The social unit recognizes the effects of public health on the overall level of productivity and economic progress, the national defense, and the proportion of national income that must be allocated to hospitals and medical care. Or consider the case of an invasion by an exotic pest which threatens to wipe out a major agricultural crop in some state. The public has an interest here in preventing the disruption of the social and environmental stability of this area. And this interest extends much beyond the individual interests of the farmers and processors who would be harmed directly by the depredations of the pest.

Such unitary public interests will ordinarily take precedence over individual interests. This will qualify a conception of the public interest as an aggregate of individual interests. It may then be legitimate to consider (aggregate) only those individual interests which do not conflict with the unitary public interest. Suppose, for example, a decision has been made that it is in the interest of the public as a unit to prohibit the use of a particular pesticide on all food crops. All subsequent decisions as to what pest control would be in the public interest may be based on an aggregation of the individual interests of farmers and other people. But the economic advantages that farmers might gain by using the prohibited insecticide cannot be included in determining their individual interests.

There are other complications: a mere count of the number of people benefited as compared to the number of people harmed is not sufficient; individuals will be affected to different degrees by any particular action and their interests must be weighted somehow in order to determine the total effect. For example, suppose that five individuals would each benefit by $1 apiece from some given action but that this same action would impose a cost of $10 on a sixth individual. The sixth individual seems entitled to more weight than any one of the other five. And in this case his loss would seem to outweigh the total gain of the other five. (This would not be nearly so clear if the five were poor men and the sixth was an extremely wealthy individual.)

Greater weight may be given to the interests of some individuals on other grounds too. For example, although certain amounts of pesticide residue can legally occur in some food products, the tolerance for such residues in milk is set at zero. This indicates that the interests of babies, children, and other large consumers of milk are given greater weight than those of other food consumers.

TESTING ACTIONS BY THE PUBLIC INTEREST

A particular proposed action might be analyzed for its effect on the public interest in the following steps:

1. Does the social group have a unitary interest in this action sufficient to outweigh all individual interests? If it does, the choice should be obvious. The cost of the action does not enter into the decision. However, once the decision is made, those who execute it have an obligation to do so at the least cost. (This would seem to be a rather rare situation in pest control.)

2. Is the unitary interest of the social group in this action insufficient to outweigh all individual interests? (This includes the case in which there is no such unitary interest.) If so, the interests of the individuals involved must be considered along with any unitary group interest.

   a. What are all of the benefits and all of the costs in terms of the basic goals that would result from the proposed action? These should be set up in the form of two arrays. They should be stated explicitly and should be quantified wherever possible.
      (1) What would be the benefits and costs in regard to any unitary group interest?
      (2) What would be the benefits and costs in regard to the individual interests of all of the individuals who would be involved? The individuals should be recognized as explicitly as possible. Where only groups can be identified, the numbers of individuals in those groups should be determined.
   b. Should all of the individual costs and benefits be given the same weight in determining the public interest or should some be given more weight than others? The following bases for weighting may be considered:
      (1) Any unitary interest of the social group may be given a different weight than is given to individual interests.
      (2) A common interest (one that is widely shared by the individuals involved) may be given more weight than unshared interests.
      (3) Some of the fundamental goals may be given a different weight than is given to other goals.
      (4) Some individuals may be given more weight than other individuals.
      (5) A gain or loss may be given different weights depending on the proportion it forms of the "stock" that exists prior to the change. (For example, if a particular food crop is already in surplus supply, any additional output of that crop may not receive much weight as a benefit of pest control.)
   c. Do the total weighted benefits of the proposed

action exceed the total weighted costs? This can be judged only in a comparative sense. The totals cannot be determined quantitatively in any meaningful manner.

This comparative analysis will lead to one of the following situations:

(1) The total benefits clearly exceed the total costs or vice versa. The magnitudes of the benefits and costs are such that the difference between them is significant even after allowance has been made for the uncertainty with which some of the facts are known. In this case the action can be said to be desirable or undesirable.

(2) Neither the total benefit nor the total cost is obviously greater than the other. The difference is not sufficiently great to offset the uncertainty regarding the magnitudes of the totals being compared. This indeterminacy may be due to a lack of information of one or both of the following kinds:

(a) The existing data may not be adequate for an accurate determination of the beneficial and detrimental effects of the action. When more facts are obtained, the desirable choice may become obvious.

(b) The existing information may not be adequate for an accurate determination of the values which the involved individuals place on the beneficial and detrimental effects of the action. When the physical data do not show either the benefits or the costs to be obviously larger, the values placed on these benefits and costs are critical factors in their comparison.

TO GENERALIZE THE PUBLIC INTEREST

The preceding discussion has implied that it would be in the public interest to take any action which would result in total real benefits that were greater than the total real costs of the action. But this idea must be qualified in two ways.

In the first place, a test which shows that a given pest control action would result in a net benefit merely indicates that this pest can be controlled in at least one way that would be in the public interest. It alone does not prove that this specific pest control action is in the public interest. There may be other kinds of actions that also will control this pest but which will do so at less cost than is involved in the tested action. It certainly is not in the public interest to accept any larger damages than necessary in exchange for a particular benefit. So before a given pest control action can be said to be in the public interest, a check must be made to determine whether the same benefits could be obtained at a lower total cost by using some different kind of action.

In the second place, a positive net benefit from a pest control action merely indicates that there is at least one way in which the resources involved in this action can be used in the public interest. It alone does not prove that the use of those resources for that particular pest control action is in the public interest. There may be other uses for those same resources which would result in larger benefits than those obtained from the pest control. It obviously is in the public interest to exchange a given sacrifice for as large a benefit as possible. So before any given pest control action can be said to be in the public interest, a check must be made to determine whether the same costs might produce a greater total benefit in some other kind of use.

This second qualification is simplified somewhat by the nature of pest control costs. It says that the real cost of using the particular resources for pest control is the value of the alternative benefits which might have been produced with those same resources, i.e., an opportunity cost. In general, those items among the costs of pest control that must be valued at their opportunity costs are those which consist of material goods and services. For example, some amounts of labor and equipment services are required to spray a pesticide over an area. These same labor and equipment services might instead be used for some alternative productive purpose. A pest control program might also involve some sacrifice of comfort by various people, but it is hard to conceive of an opportunity cost for this comfort. The sacrificed comfort represents a direct cost to the persons involved. There usually are no opportunities to sacrifice this same amount of comfort in some alternative action and to obtain different benefits thereby. This is true of most of the other fundamental goals which would be sacrificed as costs of pest control.

Material goods and services generally can be valued in monetary terms. So the "opportunity" part of the total pest control costs can be expressed as a sum of money. Those cost items which are paid for with money are the part of the total costs which must be considered in an opportunity sense. The other costs—such as sacrifice of health, comfort, aesthetic satisfaction, etc.—do not have to be considered in an opportunity sense.

The total monetary cost of a pest control program is a measure of the resources used in it. If this same amount of money would produce greater benefits in some other use, then it is not in the public interest to use it for pest control. One decision must be whether a particular sum of money can justifiably be allocated to pest control in light of the opportunity cost involved. And another decision must be whether the pest control action is justified at all when the benefits it would produce are compared with the sum total of both the opportunity costs and all other real costs.

TENTATIVE CRITERIA FOR JUDGING PEST CONTROL

We are now in a position to advance tentatively some rules or tests which may be used to try any specific pest control action in order to form a correct judgment about it.

1. The ultimate test must be the effect of the action on the public interest rather than on the interests of any particular individuals or groups.

2. The benefits and costs used in testing the action must be real benefits and real costs in terms of the relevant basic human goals.

3. With these prerequisites, an action may be judged to be desirable if it meets all of the following tests:

a. The total benefit that would result from this action must be at least as great as the benefit that could be produced in any possible alternative action by an expenditure of a sum of money equivalent to the value of those costs of the proposed action which actually can be exchanged for money.

b. The total benefits that would result from this action must be greater than the total costs that the action would involve.

c. The total costs involved in this action must be less than the total costs of any possible alternative action which would accomplish the same objective or produce the same benefit.

These appear to be criteria which an impartial outside observer might use in forming judgments about pest-control actions in which he himself is not involved. They are standards for judging an action as an isolated event which can be considered by itself. A question may be raised here as to whether this is a sufficient basis on which to form judgments about the pesticide problem. We will have more to say about this later in the report. But first we need to see what can be done with the criteria given above.

ARE THE TENTATIVE CRITERIA ACTUALLY USABLE?

The preceding section set forth some specific criteria which might be used in judging pest control actions. But earlier sections dwelt at length on the difficulties involved in determining the public interest and in identifying and measuring the costs and benefits which affect that interest. In view of these difficulties, are the proposed criteria merely theoretical concepts, or do they have practical application to the real problems of guiding pest-control activities?

An answer to this question can only be obtained by trying to use these criteria empirically in forming judgments about actual pest-control actions. The number and variety of such actions which have been and are being taken is very large. But some individual programs appear to illustrate well the kinds of problems that are involved and the kinds of conflicts which have arisen. A consideration of the historical development of one such program will provide an opportunity to try out the criteria in forming judgments about the various decisions made over the years. The problems and conflicts have been most evident in those programs that have sprayed insecticides over extensive areas from the air. One of these seems to cover much of the range of approaches to this problem and of the difficulties encountered. This is the gypsy moth control program.

HISTORY OF GYPSY MOTH CAMPAIGN

The gypsy moth is a European pest which escaped in Massachusetts in 1869. By 1890 it had spread widely enough and had done enough damage that the Massachusetts Legislature enacted a law aimed at exterminating it. Despite the crude control methods then in use, the work apparently was effective, and by 1899 it was hard to find much evidence of the insect. At this point people decided that the cost of continuing the work was not justified, and the extermination effort was abandoned. However, the insect population again built up rapidly, and before the legislature renewed the appropriation of control funds in 1905, the gypsy moth was more widely established than it had been in 1890. It is possible that the moth might have been eradicated if the original effort had been continued instead of stopping in 1900.

The first decision around 1890 to control the gypsy moth was a response to popular demand. People in the heavily infested area could see the insect at work on forests and shade trees. It was evident that gypsy moth defoliation could kill evergreens and even hardwood trees. People also had the unpleasant experience of seeing their yards and houses crawling with caterpillars. The gypsy moth was threatening their property and reducing their comfort and aesthetic satisfaction. Every choice in gypsy moth work since then traces back to this original decision that the insect was a pest and that something should be done about it.

The decision to do something was made by the Massachusetts Legislature, which was delegated by its citizens to take any action necessary for the general

welfare. Since the insect was spreading over a wider area each year, any action which stopped this spread would benefit everyone in the threatened path, and these people were more numerous than those in the infested area itself. The legislature considered this important enough to give the control agents specific authority to enter on private property in order to carry out their work. The decision to try to eradicate the gypsy moth appears to have been rational at that time. Information about control techniques and their side effects was sketchy. But the rate at which the insect spread and the damage it was doing indicated that future damage was potentially greater than the costs that might be involved in mopping up the relatively small area then infested. In retrospect—after 60 years of damage and almost $100 million spent on control efforts—if the original eradication decision could have been carried through to a successful conclusion, it would have justified more than it could have cost at that time.

EXTERMINATION PROGRAM ABANDONED

The next critical decision was that made in 1900 to abandon the extermination program. The gypsy moth was present in only very small numbers at that time. People could tolerate this small population, and the question arose of why more money should be spent in eradicating an insect that no longer was a pest. The Massachusetts Legislature knew of many alternative projects on which the money allocated to gypsy moth control could be spent. The benefits to be derived from these alternatives appeared much larger than those which could be obtained from further gypsy moth control work. So it seemed to be in the public interest to abandon the extermination program and to use the funds for other purposes.

In looking back on this decision we see a case where the total benefits apparently were not compared with the total costs. Since the gypsy moth is a cyclic insect, it is possible that the small population in 1900 represented a low point in the insect's natural abundance cycle and was not entirely a result of the extermination work. But this should not have made a difference. Any current population of gypsy moths at all appears to form a nucleus for a future epidemic population build-up. If the legislature had included on the benefit side the prevention of all the future damage to be done by successive gypsy moth outbreaks, the alternative uses for state funds would not have appeared so attractive. We do not know for sure that the moth could have been exterminated, but in view of the potential future benefits, an intensive attempt would seem to have been justified. This incident illustrates the importance of complete and accurate information in any determination of the public interest.

In the years following 1900, the gypsy moth proceeded to spread throughout New England. It was recognized as a pest, but the decision to stop the eradication effort had forfeited any chance of eradicating it. When the work picked up again in 1905, there apparently was no attempt to eradicate the moth in the main infestation. Subsequent effort was aimed at suppressing the moth to reduce damage and to prevent or slow down further spread. Eradication was tried only in cases of spot outbreaks ahead of the main infestation. Such eradication attempts in New England ultimately failed. The main infestation kept spreading, and there were no natural barriers to protect the other states.

NEW JERSEY CONTROL MEASURES

One major success stood out in early eradication attempts. In 1920 the gypsy moth was found in New Jersey, far removed from the main infestation in New England. (It had been brought from Europe on imported trees in 1911 and therefore was independent of the New England infestation.) The New Jersey Legislature promptly made a decision. In 1921 it passed a law which says in part: "The gypsy moth . . . is hereby declared to be a public nuisance and the protection . . . therefrom is deemed to be a subject matter of public welfare. Whenever . . . the department shall find evidence of the gypsy moth or its preliminary stages, it shall have recourse to such recognized measures as it may deem advisable to abate and suppress the gypsy moth. . . ." The legislature delegated the carrying out of the law to the state department of agriculture, which proceeded to conduct an energetic eradication campaign. By 1935 the last gypsy moth had been eliminated from New Jersey, and the state remained free of infestation until 1955.

The New Jersey program apparently demonstrated that eradication is feasible, though some entomologists question whether this area may not have been outside the most favorable range for the gypsy moth. It also forms an interesting example of an effort to act in the public interest. The state legislature decided that abatement of the gypsy moth would benefit enough people that it could give the Department of Agriculture the legal right to enter on any property to make inspections and to apply its recognized measures of control. But it also recognized the interests of individuals in the following clause: "At least ten days before entering any lands and premises and starting the work of abating . . . the gypsy moth . . . the department shall cause a notice to be served personally or by registered mail on the occupant of the lands . . . setting forth the nature of the action that it is proposed to take and fixing a time therefor." Individual people were to be considered, to be told what was going on, and to have ten days in which to seek further information or to object.

GOVERNMENT ATTACKS INFESTATION

The federal government entered the gypsy moth picture almost as soon as intensive control was resumed. Congress decided it was in the public interest to prevent the gypsy moth from spreading over the

rest of its possible range and appropriated money for this purpose in 1906. One possible means to this end was a quarantine to prevent the unintentional transportation of the insect into uninfested areas. But despite the quarantine, the infestation continued to spread, and the regulated area gradually had to be expanded. Finally it was decided to try to hold the line by establishing a barrier zone. A logical holding place lay roughly along the boundary between New York and the New England states. Part of this line was a natural boundary because the native Adirondack Mountain forests consisted of species on which the gypsy moth did not usually feed. In addition this line lay between the main infestation and the New York metropolitan area. If the moth should get into this metropolitan area with its many industries and transportation arteries, the quarantine would become extremely expensive if not actually impossible to maintain. This decision to establish a barrier zone seems to have been in the public interest. The quarantine worked some hardship on firms whose normal trade channels crossed this line and who had to submit to inspection and preventive treatment of their products. But the benefits to the number of people outside the infested area who were protected by the quarantine appeared to outweigh these costs.

Along with the barrier zone went a decision to eradicate promptly any spot infestations that occurred outside the main infestation. The federal government co-operated financially in this mop-up work. Since the barrier plan would collapse unless every outside spot infestation was eradicated, this was a rational secondary decision. The costs of eradicating any incipient infestation had to be compared not with the immediate values endangered in that spot but rather with the values protected by the whole barrier plan. These spot eradications apparently were handled without any pronounced conflict with local interests.

Within the infested area many specific control decisions were made over the years. These extended the basic decision to "live with" the gypsy moth but to keep the damage and nuisance effect within tolerable limits. Natural enemies were imported and released to help hold down the population. Cultural methods of control were studied but not much was learned that could be applied practically. Individual outbreaks were sprayed with insecticides. In most states such spraying decisions were based on a request from the land owner or town and usually required their financial participation. Each of these was a separate decision and in most cases probably conformed fairly well with the criteria. (It is interesting to note that in those early days much of the control work was done by spraying with arsenate of lead—which is, of course, a deadly poison. Pesticides have been a part of the problem for a long time.)

DDT ENTERS CONTROL PROGRAM

The 1938 hurricane carried the gypsy moth over the barrier zone, and the pest became established in New York State west of the Hudson River. A serious spot infestation was also found in Pennsylvania, and by the early 1940's it looked as though the insect might be free to spread westward. However, a new insecticide called DDT had been developed during the World War II and now became available to the pest-control agencies. DDT could be sprayed economically over large areas from airplanes, and tests showed that application rates as low as one-half pound per acre would kill gypsy moth larvae. But DDT was toxic to almost all insects and also to fish. In large enough amounts it would even kill birds and mammals.

The whole philosophy of gypsy moth control up to this point was based on the two ideas that the pest could be confined to New England by a combination of the barrier zone and quarantine and that it was not feasible to eradicate this insect over extensive areas. Now the barrier zone had been breached, and pest control workers had a new insecticide which was far superior to any used before, although it could have serious side effects. Some new decisions were called for.

New York and Pennsylvania decided that the infestations in their states were serious enough to justify trying DDT. But they were concerned about the lack of information on the side effects of this pesticide, so they used it to control the worst infestations but did not attempt to eradicate the moth. (New York used an application rate of only one-half pound per acre in much of its work.) The federal Bureau of Entomology and Plant Quarantine and the Fish and Wildlife Service co-operated in large scale studies in Pennsylvania to determine the effects of the spraying programs on other insects, fish, and wildlife. By 1949 the information was at hand that large areas could be sprayed efficiently from the air, that DDT uniformly applied at a rate of one pound per acre would kill all gypsy moth larvae in the sprayed area, and that one pound of DDT per acre would have no immediate effect on birds and animals but would kill some fish and many other insects.

FEDERAL-STATE CO-OPERATIVE PROPOSALS

The desirability of exterminating the gypsy moth had often been discussed, and the effectiveness of DDT made it appear that such extermination was now a real possibility. The Bureau of Entomology and Plant Quarantine in 1949 proposed a program of which it said, "The eradication of the gypsy moth from this country is the ultimate goal of the federal-state sponsored co-operative program." The objectives of this proposed program were stated as:

(1) Eradicate the gypsy moth in Pennsylvania.
(2) Eradicate it west of the Hudson River and finally from all of New York State.
(3) Apply control and eradication measures in western New England to prevent westward spread.
(4) Enforce prescribed quarantine regulations to prevent long-distance spread into uninfested areas and those cleared by eradication.
(5) Encourage the use of airplanes and mist blowers throughout infested portions of New England.

The immediate aim of this program appeared to be the re-establishment of the barrier zone, but the long run objective was stated to be complete eradication.

In January, 1950, an interstate conference on gypsy moth control was held in Boston under the sponsorship of the Massachusetts Commission on Interstate Co-operation and the Council of State Governments. Representatives of the New England states, New York,

New Jersey, and Pennsylvania attended. The first resolution passed at this conference called for "adequate federal budgetary support to finance the spraying of at least one million acres per annum for the eradication of the gypsy moth." This conference established the Regional Co-ordinating Committee on Gypsy Moth Control which has played an active role since that time.

Despite these developments, control of the gypsy moth continued to be on a piecemeal basis. No concrete action was taken on the 1949 proposal. New York and Pennsylvania continued to spray with DDT, and the New England states began to use this technique in their control work. A program in Massachusetts in 1948 and 1949 was so successful as to give promise of ridding the state of its old enemy. But objections appeared from sportsmen, mink farmers, and other sources. Some of these objections were groundless and some were resolved, but the legislature held back on approval of a statewide eradication program. Recognition was being given to the side effects of gypsy moth control and the question of whether the benefits of an eradication attempt would outweigh its real costs.

In 1951, a study group appointed by the Secretary of Agriculture after considering the gypsy moth problem recommended "that the entire infested area be treated for eradication in a period not to exceed five years." In 1952 a special commission in Massachusetts recommended that the state undertake a statewide program of aerial spraying to eradicate the gypsy moth. This strong emphasis on eradicaton aroused many to the need for careful planning. The Regional Co-ordinating Committee on Gypsy Moth Control called on the Department of Agriculture to prepare "a co-ordinated and detailed plan for the eradication and/or control of the gypsy moth in the states of the region."

AGENCIES STUDY CONTROL POLICIES

In 1952 the Bureau of Entomology and Plant Quarantine and the Forest Service with the co-operation of the state agencies set out to assemble the facts which were needed to evaluate the problem and to determine future control policy. The appraisal tried to determine:

(1) the limits of the general infestation and the area susceptible to defoliation in New England and New York;

(2) the loss caused by the gypsy moth in killing trees, retarding growth, and deteriorating forest stands, and also the loss in intangible values;

(3) the susceptibility of stands in the hardwood forests outside of the New England-New York area to damage by the moth.

The appraisal was made by entomologists and foresters who were familiar with the insect and with the area. They found some 30 million acres infested with the gypsy moth, of which about five million appeared susceptible to serious defoliation. They estimated that the moth had done tangible damage of about $6.6 million between 1933 and 1952 plus intangible damages equal to or perhaps greater than this amount. And finally, they estimated that about 100 million acres of oak forests outside of the present infested area are highly susceptible to damage if the gypsy moth should get into them.

SEVEN-POINT PROGRAM RECOMMENDED

Based on this appraisal, the Bureau of Entomology and Plant Quarantine drew up a new program for gypsy moth control. A number of the states were reluctant to undertake an eradication program at that time. Serious doubts had been expressed as to whether it was really practical. So the bureau did not suggest a general eradication program. Instead it recommended the following actions:

(1) Establish a barrier zone along the perimeter of the regulated area in Connecticut, New York, and Vermont, extending from Long Island to the Canadian border.

(2) Try to eradicate the gypsy moth within this barrier zone.

(3) Suppress outbreaks east of this zone which might spread into it.

(4) Promptly eradicate infestations that occur in areas west and south of the barrier zone.

(5) Apply controls to prevent economic and aesthetic losses within the infested region itself.

(6) Strengthen quarantine operations.

(7) Establish study plots in the infested region to obtain information on the expectable occurrence of defoliation and the factors that influence the cyclic fluctuations in moth abundance.

This seven-point plan was approved in 1953 by the Regional Co-ordinating Committee of the Council of State Governments. They recommended that the states urge Congress to appropriate funds for this co-operative program. If this program were successful, it would re-establish the situation that had existed before 1938 with the gypsy moth confined to New England and held at tolerable population levels there by local control. This is the only program on which all of the affected states apparently have been able to agree.

The seven-point proposal was based on the most thoroughgoing analysis of the gypsy moth problem up to that time. But does it meet the cost-benefit standards of our tentative criteria? The printed report of the appraisal estimated the historical damages at about $12 million over a 20-year period and stated that some $20 million had been spent on control work during that same period. It did not compare either figure with an estimate made elsewhere that complete eradication of the pest would cost at least $30 million. Aesthetic and recreational losses due to the moth were cited, but nothing was said about the real costs of the side effects of an extensive application of pesticides. Emphasis was placed on the 100 million acres of oak forests in the potential line of spread, but some ento-

mologists question whether the moth would spread over all of this area and how it would act in those different environments. The lack of facts prevents a complete cost-benefit analysis, and it seems impossible to say at this distance whether the seven-point proposal was desirable as tested by our criteria.

SEVERE EPIDEMIC OCCURS

The gypsy moth was at a low level of abundance in 1952 throughout most of the infested area. Since it did not appear to be an urgently pressing problem, the necessary support was not forthcoming for the full seven-point program. Local control efforts and enforcement of the quarantine continued as before. Then conditions changed drastically. A rapid build-up in the gypsy moth population in 1953 and 1954 brought an epidemic situation of unprecedented severity. Control measures failed to hold the pest in check and new infestations appeared in New York, Pennsylvania, New Jersey—which had not had the moth since 1935—and Michigan, which had never had it. A decision for eradication was promptly taken in Michigan and New Jersey where the potential damage loomed large. But New Jersey complained that it was fighting a losing battle unless reinfestation was prevented. The gypsy moth in its epidemic numbers was an intolerable pest and the people petitioned their representatives in Congress and in the state legislatures to do something about it. The states in the path of the spread were thoroughly alarmed. The Regional Coordinating Committee of the Council of State Governments, the Plant Boards, and the National Association of Commissioners, Secretaries, and Directors of Agriculture discussed the problem energetically.

The Plant Pest Control Branch of the Agricultural Research Service (which had inherited the control functions of the Bureau of Entomology and Plant Quarantine) decided it would be desirable to get together with the states and reappraise the gypsy moth situation. The new outbreaks had raised a question of whether the existing suppressive and regulatory operations were adequate to hold the moth in check. And the federal agency was already concerned about the ever-increasing recurring annual costs for control and quarantine enforcement. A meeting was held in Washington, D. C., on March 5, 1956, and was attended by representatives of fifteen states.

SEVERAL SOLUTIONS OFFERED

Three possible alternative courses of action were suggested to those attending this meeting:

(1) Revise the federal quarantine to include the newly infested areas and concentrate federal effort on the prevention of long-distance spread, leaving the responsibility for necessary control work within the infested areas to the states.

(2) Undertake an expanded spray program designed to eliminate immediately the infestations in New Jersey, Pennsylvania, and Michigan and to apply the initial treatment to infested areas west of the Berkshires and the Green Mountains. (The federal government would also co-operate with the New England states in necessary local control measures.)

(3) Undertake immediately an all-out program of eradication to be accomplished within a period of eight to ten years.

The second of these possibilities was in effect the same as the seven-point plan which had been proposed in 1952 and approved unanimously by the infested states. It would re-establish the barrier and more or less put things back where they had been before the 1938 hurricane. However, the Plant Pest Control Branch still felt that eradication was feasible and discussion at the meeting actually was confined to the third alternative—immediate all-out eradication. The federal agency estimated that the aerial spraying phase of such a program would cost about $30 to $35 million.

There was disagreement among the state representatives. New Jersey—with a memory of successful eradication—and Pennsylvania favored the all-out eradication effort. They felt that this was the only means of preventing periodic reinfestations of their states. New York—which had been battling the moth with only limited success in the bulge west of the old barrier—was not so sure. The other states in the line of potential spread were all in favor of complete eradication. They did not have the gypsy moth and did not want it. But neither did they know all the problems involved in trying to root out such a firmly established pest, said the infested states. These states in the generally infested area, which would bear the brunt of the eradication effort, did not feel that they should be committed to an all-out eradication program.

Apparently the representatives at this meeting did not attempt to compare and choose between the three alternatives that had been presented to them. The first approach—continuation of the federal quarantine and gradual revision of the boundaries of the quarantined area to include newly infested areas as they occurred—was already in effect. The purpose of the meeting was to see what might be done to supplement or replace this existing program. (There was a fourth possible course—to abandon the quarantine and limit the gypsy moth control work to the suppression of intolerable outbreaks when and where they occurred. The fact that this alternative was not mentioned implies a feeling that the benefits from confining the gypsy moth exceed the present costs of quarantine and regulatory action.)

The second alternative—to re-establish the barrier zone—had received unanimous approval when proposed in 1952 but never had been implemented. The proposition now was being placed to the states that they co-operate in an all-out eradication effort. The problem was not really to choose between re-establishment of the barrier zone and all-out eradication. The question was whether to undertake an all-out eradication program or not. It was on this point of accepting a commitment to all-out eradication that the generally infested states balked.

The disagreement finally was resolved by a compromise. Eradication of the gypsy moth was accepted as a tentative ultimate goal. But the program was to start on a gradual basis, and the states were not committed from the beginning to a continuing eradication effort. The immediate goal was to be the extermination of the known infestations in Michigan, New Jersey, and Pennsylvania and eradication of the insect from a protective border in New York State. This would be followed in succeeding years by a

progressive series of eradication treatments working inward from the periphery of the infestation. The program was to be evaluated on a year-to-year basis and changes could be made as the program progressed. This met the objection that no one had ever demonstrated that eradication of the gypsy moth over such extensive areas was really possible. At the same time it permitted the advocates of eradication to make a start on their desired program.

FEDERAL APPROPRIATIONS REQUESTED

As a result of this meeting, Congress was asked to appropriate money for a start on the proposed eradication work. The first federal funds for this new eradication effort were made available in 1956 and the appropriation was increased in 1957.

Was this compromise decision to start an eradication effort against the gypsy moth desirable in terms of our criteria for judging the public interest? This question can only be analyzed by dividing it into parts. The first partial question is whether it would have been in the public interest to commit the states and federal government to an all-out eradication effort at that time and to begin immediately on spraying operations of the size required to cover the entire infested area in eight to ten years. The direct tangible benefits of successful eradication of the moth would include the saving of the annual damage done by the pest (which the 1952 appraisal had estimated at $600,000 per year during the preceding 20 years) and the saving of the annual control and quarantine costs of some $2 million. Successful eradication might thus result in a continued saving of about $2.6 million each year. The direct costs for the spraying over the eight to ten years considered necessary to complete the eradication were estimated at $30 to $35 million.

DDT EFFECTIVENESS ANALYZED

When the elimination of the threat to the non-infested areas is added in, the potential benefits appear quite large compared to the costs. But these costs do not include the real costs of the side effects of such an extensive application of DDT. Such costs clearly would arise but it is hard to determine how large they would be. More serious for this analysis are the questions which were raised as to whether one spraying with DDT and subsequent mop-up work really would eradicate the moth. The estimates of benefits and costs would stand up only if the eradication treatment were completely effective. A need to repeat the spraying treatments or the survival of even small pockets of infestation would completely change the cost-benefit picture. The fact that well-informed entomologists did not agree (and still do not) on the feasibility of eradicating the gypsy moth everywhere introduces a major item of uncertainty into the analysis. Considering the uncertainty of both costs and benefits, it seems doubtful that it would have been in the public interest to have launched a full-scale eradication effort in 1956.

The second partial question is whether it was in the public interest to undertake to exterminate the known infestations in Michigan, New Jersey and Pennsylvania. These were all new infestations, were in areas that had been free of the gypsy moth previously, and were not contiguous with the main infestation. They showed signs of spreading over wider areas. Earlier infestations had demonstrated that the gypsy moth could thrive and do damage in New Jersey and Pennsylvania. Since these spots were isolated from the main area, the possibility of their being reinfested from outside after an eradication was not serious. The infestations were relatively small—somewhat over 300,000 acres in New Jersey and Pennsylvania and about 100,000 in Michigan (compared to 30 million acres in the main infested area). The total side effects, therefore, were not likely to be as severe as in an all-out eradication effort in the main infestation. The costs and benefits of these isolated eradication treatments cannot be quantified, but it seems likely that the benefits exceeded the costs.

This conclusion is strengthened by the fact that these isolated areas provided a place to test the possibility of exterminating extensive gypsy moth infestations by aerial application of DDT. The uncertainty as to whether such an extermination really was possible prevented a conclusive demonstration that an extermination program would be in the public interest. It appears that it was desirable to find out through extensive tests whether eradication was possible.

AREAS SELECTED FOR SPRAYING

The question of whether the spraying of the border strip in New York was in the public interest is more difficult. This was part of the main area and therefore subject to reinfestation. The acreage involved was much larger than that in the other states. However, both the complete extermination of the pest and the alternative of pushing it back to the barrier zone hinged on the eradication of the gypsy moth from New York State. Unless the possibility of doing this could be established, there was no way to decide whether either of these proposals would be in the public interest. On this basis it may be argued that it was in the public interest to take the first steps in the compromise program of 1956. The importance of the 1956 and 1957 spraying programs as sources of information on costs and benefits will be evident in what follows.

The compromise decision called for immediate elimination of the known infestations in Pennsylvania, New Jersey, and Michigan and the spraying of a protective border in New York State. A start was made on this with the spraying of DDT at a rate of one pound per acre over 677,000 acres in these states in 1956. (Eighty-one thousand acres of this was a continuation of the eradication program started by

Michigan in 1954. The decision to eradicate the pest from Michigan had been made before, and independently of, the 1956 general decision.) Since about 250,000 additional acres were sprayed in 1956 by the states in their own control (not eradication) programs, almost a million acres were sprayed in that one year for gypsy moths alone. The wildlife, nature, and similar groups had already been concerned about the effects of aerial spraying of pesticides. This increase in the area being sprayed perturbed them. But they were most upset to see large solid blocks of land completely sprayed and to learn that this would be the pattern of the eradication program just getting under way. Anyone could easily calculate that an average of over three million acres would have to be sprayed each year if the existing infestation was to be eradicated in ten years as the Plant Pest Control Branch had proposed. And the plans being discussed for 1957 bore out this figure. These groups objected publicly to a continuation of this large scale spraying program. In addition, the control agencies received a number of complaints of damages from people in the areas sprayed in 1956.

SPRAYING PROGRAM CONTINUED

Despite the repercussions of the 1956 spraying program, the state and federal co-operators went ahead with their eradication plans for 1957. These called for spraying the remainder of the known infested areas in New Jersey, Pennsylvania, and Michigan and extending the protective border in New York State. A total area of over three million acres was planned for spraying with about 2.5 million of this in New York. This was a continuation of the compromise decision to try a progressive eradication program. But as an incremental decision, was it in the public interest to continue and expand the eradication program in 1957?

The state agencies in New Jersey, Pennsylvania, and Michigan checked on all the 1956 claims of damages, since the states were liable if the claims were valid. They found some false claims, such as those by people who lived well outside of the area actually sprayed. People who claimed damage to their automobile finish were shown that the spray could be washed off with water. Some immediate claims of damage to orchards and crops settled themselves when the season progressed and the damage failed to materialize. The state fish and game departments found some losses of fish — though not serious — and no losses of birds or mammals. The state pest control people felt they had good evidence that the side effects of the one-pound-per-acre spray were quite limited. Compared to the number of people benefited by wiping out the gypsy moth in these three states, the number harmed by side effects appeared very small. Since these agencies already had been delegated the authority to suppress the moth, they considered it in the public interest to complete the eradication in their states. The evidence seems to support them in this view.

NEW YORK CONTROL PROGRAM

The situation with regard to New York is not quite so clear. The Conservation Department is empowered by law to take measures to control the gypsy moth. But the Department of Agriculture and Markets also is empowered to act. The state law says: "The Commissioner (of Agriculture) shall take such action as he may deem necessary to control or eradicate any injurious insects or plant diseases existing within the state." The Conservation Department had earlier decided that it could not eradicate the gypsy moth from New York and had built up a program of suppressing individual outbreaks with light aerial applications of DDT. It did not subscribe to the general state-federal decision on eradication. However, the federal Plant Pest Control Branch had a close working relationship with the Department of Agriculture and Markets, and this department agreed to support the eradication effort in the protective border in 1956. (The federal agency has always interpreted strictly that part of the federal law which says "In performing the operations . . . herein authorized, the co-operating . . . state . . . shall be responsible for the authority necessary to carry out the operations . . . on all [non-federal] lands and properties within the . . . state.") About 350,000 acres were sprayed in this border in 1956. Various complaints of damages were made as in the other three states. Although some of these were real, they did not appear to be of serious magnitude.

The state and federal co-operators went ahead with their plans for 1957. These were to push the infestation back to the east and the north in New York State. This would re-establish the southern anchor of the barrier strip on Long Island and provide a base from which to work back to the rest of the barrier. Assuming that the 1957 programs proved successful in New Jersey and Pennsylvania, the New York program would eradicate the moth up to the Connecticut line in the south and would start to eliminate the bulge west of the Hudson River. New Jersey would be protected from re-infestation. And, perhaps more important, the threat of infestation of the New York City metropolitan area would be reduced. The 1957 spraying program in New York seemed to have large public benefits to recommend it.

LONG ISLAND PRESENTS PROBLEMS

Some different things had to be weighed on the balance in this case, however. The area to be sprayed on Long Island and in Westchester County consisted largely of heavily populated municipal and suburban centers. Here it was not a case of spraying extensive forested areas where relatively few people lived. This was an agricultural and suburban area with only intermingled patches of woodland. Many devotees of organic gardening lived in this area — people who grew vegetables and fruit without the use of chemicals in any form. And to further complicate the situation, gypsy moths were not numerous in most of this area in 1956. Following the epidemic numbers of 1953 and 1954, the moth was now entering the low stage of its periodic fluctuation. Long Island apparently was not heavily infested anyway, and at this time the caterpillars were so few as to be unnoticed.

The earmark of an eradication program is that the insect must be completely exterminated. Pest control workers had trapped male moths and found some egg masses on Long Island. They knew that the insect was there. And no gypsy moth worker ever forgets that the whole disastrous situation started with the escape

of only a *few* moths in Massachusetts in 1869. The logical procedure was to spray the whole area and not just the immediate localities where evidence of the moth had been found. This would not be an absolutely complete blanket spraying. In recognition of the side effects, the pilots would be instructed to turn off the spray over cow pastures, ponds, streams, and orchards in bloom. Small timbered areas near these might be picked up with ground spraying apparatus. But in general the aerial spraying would have to cover all places where the gypsy moths might be if it was to be effective. The plan for 1957 was to spray most of an area of 2.5 million acres.

OBJECTIONS RAISED TO SPRAYING

When it became known that this large program was planned for 1957, some people began to object. Individual complaints were made, but the pest control agencies did not consider these sufficiently important to change their plans. However, a group of Long Island residents pooled their objections and on May 8, 1957, filed a complaint asking the court to grant a temporary injunction immediately and later a permanent injunction to restrain the pest control agencies from spraying pesticides on their property. After a hearing and consideration of the affidavits which were filed, the judge refused to issue a preliminary injunction. Meanwhile the spraying program was already under way and the agencies in charge proceeded to complete it. The plaintiffs were not deterred by the denial of the preliminary injunction which permitted the spraying to go on as planned. They next started action aimed at obtaining a permanent injunction and this came to trial in the United States District Court in February of 1958.

Several other things happened in connection with the 1957 spraying in New York that should be noted. The Plant Pest Control Division notified the City of New York that it was going to spray for the gypsy moth and wished to include the tree growth around reservoirs and water courses under jurisdiction of the city. The City Department of Water Supply, Gas, and Electricity was convinced that any aerial spraying of the marginal protective strips would contaminate the water supply with DDT and refused to permit spraying over these areas. It did, however, grant permission for spraying at a distance of not less than 500 feet from the shore lines provided the work was done according to certain stipulated conditions. Pest control actions were here controlled by an agency with a concern for human health. The eradication program was beginning to be tested in terms of the non-monetary costs involved. This decision left a serious problem for the control agencies of how to eradicate the gypsy moth in the watershed lands, because any infestations left there would surely spread.

Another happening of significance was the rather widespread newspaper coverage of the spraying program. Much of this was factual but some tended to editorialize and some even approached the "scare headline" and sensational type of journalism. The pest control workers felt that it was hard to get their side of the story across and that the public was receiving a biased picture of the program. This feeling appears in a statement released by the Department of Agriculture on May 10, 1957. It said in part: "Three government agencies joined today in a public statement . . . endorsing the safety of methods established for the conduct of the . . . spray program . . . against the gypsy moth . . . the reason for this joint statement is the fact that a number of reports have been published during the past few days which may have unduly alarmed the public concerning alleged hazards to both human health and wildlife from using DDT to eradicate the gypsy moth." The three agencies were the Public Health Service, Fish and Wildlife Service, and Agricultural Research Service. The unfavorable and sensational publicity brought the problem to the attention of the public and prodded the pest control people into more explanations of "how and why" than they had been wont to give.

CONTAMINATION CURBED

Finally, the 1957 spraying area contained many pastures. Even though the pilots had instructions to turn off the spray when crossing these pastures, some DDT did get onto pasture grass and forage crops. It is a characteristic of DDT—as of many other substances—that it is excreted in the milk of a cow who receives it in her food. The tolerance required by the federal Food, Drug, and Cosmetics Act had been set at zero for all pesticides in milk. So milk containing any residue whatever of DDT could not legally move in interstate commerce. The state of New York also had established a policy of preventing the sale of any dairy products which contained detectable amounts of DDT. The contamination of forage with DDT thus brought the eradication program into conflict with efforts to achieve the goal of good health. But if the pest were to be eradicated, it had to be killed on pasture trees, fence rows, and similar places which were difficult to spray from the air without also spraying the grass areas.

The strong reactions in New York State to the 1957 spraying program called for a reconsideration of all-out eradication. The Plant Pest Control Division and the state agencies concerned felt that the program was progressing successfully. Only 471 complaints had been filed in connection with the 1957 spraying operations. This did not seem like many complaints from such a large area if serious damages really were being done. The complaints appeared even more trivial when it was found that almost half concerned spray falling on automobiles and many of the others were not substantiated.

However, there were public objections and this might well be the best time to try to resolve them. Spraying would not be needed in New Jersey and Michigan in 1958 because the programs there apparently had been a success. Pennsylvania had discovered

a new infestation on a mountain top which threatened to spread widely. The state felt it had support among its own people for an eradication effort in 1958 against this infestation. The court trial on the application for a permanent injunction by the Long Island residents would be held some time during the winter of 1957-1958. This would provide a chance to bring into the open with expert testimony all of the charges levelled against the spraying program and to obtain a judicial decision as to their validity. And since the next logical place to proceed with the all-out eradication program included many dairy farms, it was imperative to find some solution to the problem of DDT residues in milk.

SPRAYING CURTAILED DURING 1958

A decision was therefore made to hold the eradication effort in abeyance during 1958 except for the spot program in Lucerne County, Pennsylvania. Work was stepped up on the effort to find a substitute insecticide for DDT—one that would kill the gypsy moth effectively but that would not produce any residues in cow's milk. This was not an abandonment of the all-out eradication decision. It was an effort to get more correct answers to the factual questions involved so that future actions could be more effective in achieving the goal of eradication. Since the gypsy moth population was at a low ebb generally, the eradication effort could be postponed temporarily without involving serious losses or risks of further spread. (The individual states did spray some 40,000 acres in 1958 to suppress spot outbreaks which were intolerable.)

"GYPSY MOTH TRIAL"

Testimony in the "Gypsy Moth Trial" was heard by Judge Bruchhausen from February 10 to March 4, 1958. Some 50 witnesses testified on one side or the other. The specific request of the plaintiffs was that the agencies responsible for the aerial spraying programs be permanently restrained from such spraying on the lands, homes, and persons of the plaintiffs or from spraying near enough to endanger these. The plaintiffs' individual properties merely provided a test case. Their real hope was to stop the aerial spraying programs generally. In order to make their case, the plaintiffs apparently tried to marshall every possible reason for objecting to the spraying program. The testimony thus presents a rather exhaustive display of the effects of the aerial spraying of DDT on the ultimate human goals involved.

The objections to the spraying program which were presented by the plaintiffs fall into seven major categories:

(1) The spraying of DDT from the air at the rate of one pound per acre is injurious to the health of human beings.

(2) Such spraying does serious damage to birds, fish, bees, and growing crops.

(3) The spraying was not necessary because there were few, if any, gypsy moths in the area.

(4) Spraying with chemicals is not necessary because biological controls will keep the gypsy moth from being a serious pest.

(5) Spraying with DDT at the rate of one pound per acre will not eradicate the gypsy moth from an area.

(6) The actual application of the spray was not properly done and this caused unnecessary annoyance and damage.

(7) The pest control agencies are not authorized by law to engage in mass aerial spraying of insecticides.

COURT DECISION FAVORS DEFENDANTS

On June 23, 1958, Judge Bruchhausen rendered his opinion that the acts of the agencies carrying on the spraying were authorized and that the plaintiffs had not made a clear showing for equitable relief. On September 29 he ordered that the action for a restraining injunction be dismissed. The plaintiffs then appealed this judgment to the United States Court of Appeals.

It is informative to see how Judge Bruchhausen arrived at his opinion, since this is a decision of major significance to the use of pesticides for insect control. We will start with the seventh objection above—that the agencies were not authorized by law to carry on the program. The principal issue of law, according to Judge Bruchhausen, was whether the spraying operation was a valid exercise of the state's police power. In his opinion he says that "Private rights must be abridged by the exercise of police power and must give way to the public interest." But "police power may not be resorted to by a legislature unless its use is in the public interest or for the general good of the people." Evidence existed that the gypsy moth had caused tremendous damage and was a continuing threat. The legislation enacted by Congress and the New York Legislature authorizing the control or eradication of the gypsy moth was therefore clearly in the public interest.

He then goes on to say: "A further limitation on the exercise of police power is that the action taken must have a reasonable or substantial relation to the object sought to be accomplished—in this case, the control or elimination of the gypsy moth. Mass spraying with an insecticide obviously bears such relation. The plaintiffs have not successfully refuted this point." He felt that the plaintiffs had not established the facts which they claimed in objections (3), (4), and (5) above. Particularly, he said: "The assertion . . . that the danger of the gypsy moth is remote has not been sustained, especially with the knowledge that the escape of a few moths . . . in Massachusetts originally created the problem, not only in that state but far beyond its borders." His conclusion was that "the mass spraying has a reasonable relation to the public objective of combatting the evil of the gypsy moth and thus is within the proper exercise of the police power by the designated officials."

INSUFFICIENT EVIDENCE

This conclusion, of course, rested on the findings with regard to objections (1), (2), and (6). A great deal of emphasis was placed in this case on the subject of human health. Almost one-third of the testimony presented in the trial concerned the effects of

DDT and aerial spraying on health. The importance that Judge Bruchhausen attached to this matter is evident from the fact that over one-fifth of his written opinion is devoted to the effects of DDT on the health of human beings. He noted first that the plaintiffs had presented no evidence that anyone was made ill by the spraying of DDT in the Long Island area. Then he recognized the difficulty in arriving at a definite conclusion as to the overall effects of DDT. He reviewed carefully the testimony of the four doctors presented by the plaintiffs and the three doctors presented by the defendants. Concerning Dr. Wayland J. Hayes— a defendants' witness—he said: "I was strongly impressed with this witness, especially because his opinions are supported by actual tests with measured amounts of DDT and by scientific evaluation of the results." Judge Bruchhausen finally decided that the plaintiffs had failed to establish that the spraying was injurious to health.

The judge also concluded that the plaintiffs did not sustain their claim that spraying caused a considerable loss of birds, fish, bees, and insects. He could see no proof that DDT injures plants as living organisms nor that plants absorb it from the soil and transfer it to edible portions.

ADEQUACY OF PLANNING QUESTIONED

Finally he considered the question of whether the spraying was properly done. He said that he could "readily comprehend the reaction of the resident, drenched with the spray . . . while walking to the railroad station as well as the attitudes of those meeting with similar experiences at or near their homes." But, he said, "It would seem that the plaintiffs' major complaint is of annoyance, rather than damage." The total number of individuals so affected was small because the spraying was done early in the morning. He admitted that the operation had not attempted to avoid such small areas as railroad stations, kitchen gardens, swimming pools, and vehicles. Also that some areas were probably sprayed more than once. He said, "It is evident that more intensive planning, preparation and caution should be exercised in connection with spraying a highly developed and built-up section such as Long Island than in the case of woodlands in more isolated areas." He indicated that there was room for improvement but he concluded that the spraying program had not been conducted improperly.

The "Gypsy Moth Trial" was the most thoroughgoing test that ever had been applied to the gypsy moth control program. This test was made largely in terms of the criteria which have been proposed in this report. Testimony at the trial indicated that the gypsy moth interfered seriously with people's attainment of some of their basic goals in the already infested areas. If allowed to spread over its possible range, it apparently would affect many more people than already were involved. The evidence that was presented indicated that one spraying with DDT at the rate of one pound per acre would come near enough to eradicating the pest that the job could be completed by mopping up any remaining spot infestations from the ground. The amount of DDT that would reach the ground from *one* application at this rate was said by well-informed people to have no effect on birds, mammals, people, or plants and only a slight effect on fish and other insects. All of the answers to questions about the side effects of an aerial application of DDT are not completely known. But because the amount of poison applied is so small, the best-informed opinions are that the effects would be negligible. The magnitude of the side effects caused by spraying appears so small by comparison with the possible damage threatened by further spread of the insect, that even if these side effects are grossly under-estimated they would seem to be outweighed by the potential damage. Control of the insect by aerial spraying with DDT appears rational in terms of physical costs and benefits.

When it comes to value questions, the program conforms with laws established by the state and national legislatures. The number of people who might have been adversely affected in one way or another in the sprayed area is smaller than the number of people in the uninfested areas who might be protected by the spraying. The question seems to be whether everyone who would be affected was considered and informed of how and why the decision was made. Although Judge Bruchhausen did not find that the spraying had been done improperly, he did imply that it could have been handled better. To some of the individuals involved—such as the organic gardeners—the spraying caused serious individual losses. Although these losses appeared to be outweighed by the gains of the people who benefited, they still were losses to the individuals concerned. If such individual losses could be reduced in any way without preventing the continuance of the program, it would be in the public interest to do so. There is evidence that this could be done by more thorough planning, by more careful control of the spraying itself, by more adequate warning and advice to the people who would be affected, and perhaps by the use of helicopters or ground spraying equipment in especially sensitive areas.

JUDGE'S VERDICT ANALYZED

It is important to note that the verdict in the "Gypsy Moth Trial" did not necessarily support the idea of an all-out program to eradicate the gypsy moth from the United States. What Judge Bruchhausen decided was that in view of the evidence presented to him, the federal-state co-operators did not act improperly in spraying the Long Island area with one pound of DDT per acre. This decision was heavily influenced by the evidence that spraying this area would prevent the *spread* of the gypsy moth in other, uninfested areas. In effect, the decision says that aerial spraying with one pound of DDT per acre is (based on the evidence presented in 1958) a legitimate means of attacking the gypsy moth. It does not say whether

the gypsy moth should be eradicated, confined to some prescribed area, or merely suppressed whenever it becomes intolerable locally. The major significance of the verdict is that it did not rule out aerial spraying with DDT as a tool for insect pest control.

The only large spraying program undertaken in 1958 was in Pennsylvania. This covered 493,000 acres and was the largest undertaking of its kind in the state's history. The program was carefully planned. An effort was made to see and explain the program to all rural property owners and all township, borough, and city officials. Particularly sensitive areas were mapped and treated with small biplanes. These included 8 mink ranches, 38 public water supply reservoirs, 4 fish hatcheries, more than 80 dairy farms, and numerous lakes and small private fish ponds. Very few complaints were received, and all but one of these involved fish killed. Every body of water in the area was checked three times after the spraying. Some fish were killed, but the numbers were not large enough to be serious. This program shows the results of the previous years' reactions. Individuals who would be involved were not only considered but were informed. And an effort was made to use all available information about how to reduce the side effects to a minimum.

NEW INSECTICIDE DEVELOPED

Elsewhere, work was concentrated on trying to develop a new insecticide which would not leave residues in milk, on improving trapping and other survey methods, and on improving the actual application techniques to avoid misses and overlaps. Confidence in the success of the eradication work was somewhat shaken by the trapping of moths in Michigan where it was thought the pest had been eliminated. Definite plans were made for spraying 20,000 acres in Michigan. As before, there was no question but that the effort to wipe out this spot infestation should continue. A new chemical—sevin—was tested and showed considerable promise. It was more expensive than DDT but did not leave any residues in cow's milk and apparently was about as effective against the gypsy moth as DDT.

1959 PROGRAM STUDIED

A decision now had to be made on what to do about the gypsy moth in 1959. The Plant Pest Control Division wished to push ahead with the eradication program. It felt that Judge Bruchhausen's decision in the "Gypsy Moth Trial" vindicated the wisdom of this program. The apparent success of the 1958 program in Pennsylvania and the lack of objections there were encouraging. But the opponents of aerial spraying were more vociferous in 1958 than ever before. Late in 1957, the Plant Pest Control Division had inaugurated a program in co-operation with affected southern states to eradicate the imported fire ant. This was an aerial spraying program but used dieldrin and heptachlor—both of which are much more toxic than DDT —at an application rate heavier than that used against the gypsy moth. The side effects of this program were more pronounced than in the case of the gypsy moth and various "conservation" groups immediately denounced it. The reaction to the fire ant program picked up momentum and the controversy became exceedingly bitter as 1958 wore on. The opponents of aerial spraying used the fire ant program to whip up public sentiment against all spraying of pesticides. The pest control workers found it difficult to counter the dramatic and highly emotional criticisms leveled against them. Some of their efforts to do so apparently only made things worse. Despite the fact that most of the critical discussion in 1958 concerned only the fire ant program, the decision for continuation of the gypsy moth work had to be made in the very unfavorable atmosphere generated by that discussion.

In speaking before the Regional Co-ordinating Committee on Gypsy Moth Control of the Council of State Governments in December, 1958, Regional Supervisor H. L. Smith of the Plant Pest Control Division said "in considering the future of eradication in New York and the New England States, we are at the crossroads." It appeared that the eradication program might either have to go forward or else be abandoned. The program, which had stepped up from 700,000 acres in 1956 to 3 million acres in 1957, had dropped back to 500,000 acres in 1958 and might be back to zero in 1959. Congress had approved the idea of gypsy moth eradication and had made funds available for it. Unless these funds were used they would almost certainly be withdrawn. The Regional Co-ordinating Committee considered a proposal to treat 200,000 acres in New York State with DDT, and an additional 560,000 acres, which was mostly in pasture, with sevin but neither approved nor disapproved this program.

AGREEMENT TO USE SEVIN

The final decision on what to do in New York was not made until March of 1959. The state then agreed to co-operate with the Plant Pest Control Division in spraying an area with sevin. (Both the Conservation Department and the Department of Agriculture and Markets co-operated this time, as did Cornell University, which had done much of the developmental work on sevin.) The sprayed area lay in the southwest portion of the infestation bulge west of the Hudson River and adjoined part of the area treated in 1957. The 1959 program thus represented a small continuation of the effort to eradicate the infestation gradually from the periphery inward.

Partly because of technological difficulties, the gross area sprayed with sevin in 1959 was not quite 86,000 acres. The new chemical was applied at a rate of 1.25 pounds of technical sevin in one gallon of oil per acre. The 1959 experience indicated that sevin is effective in controlling the gypsy moth but that it is not as satisfactory as DDT as an eradicant. A vigorous effort was made to inform people in the sprayed area about the program and to determine any side effects which the sevin might have. A large number of bees were killed but this had been anticipated and explained to the bee keepers. The general public reaction in the area apparently was not antagonistic to the program.

Elsewhere, spraying for the gypsy moth in 1959 was of modest extent. The New York Conservation Department continued its policy of spraying only those areas where infestation was heavy enough that serious damage to forest stands would have resulted if they were left untreated. Some 54,000 acres were treated in New England but only one-fourth of this was

sprayed from the air, the rest being done by mist blowers. Michigan continued its eradication program with the spraying of 20,000 acres. All of these treatments used DDT except for some experimental work in Connecticut. The total area given an *eradication* treatment was only 106,000 acres—the smallest since the program got under way in 1956.

MOTH TRAPPING PROGRAM

The trapping program in 1959 produced some discouraging news. Male moths were trapped in two places each in Michigan and New Jersey and one place in Pennsylvania. Michigan plans to spray ten to twelve thousand acres in 1960. The other two states will probably apply an eradication treatment to the areas where the moths were found. The director of the New Jersey Division of Plant Industry says they have always felt that mopping-up operations could be expected for a number of years after an eradication effort. Officials of all three states maintain their confidence that the moth eventually can be eradicated.

More serious is the fact that a large number of male moths were trapped on Long Island in 1959. This is the area which received the eradication treatment in 1957 and where no moths were trapped in 1958. The federal officials speculate that some time during the 1959 season there was a movement of male moths onto Long Island from untreated areas (presumably Connecticut) by wind dissemination. However, the gypsy moth population is known to have increased and become more widespread in the generally infested area in New England during 1959. This may be the start of the periodic upswing in population and if so it is now that the descendants of any insects which survived the eradication treatments would make themselves known. Eradication apparently is not yet an accomplished fact. Unfortunately it may be difficult to prove whether the reappearance of the pest in eradicated areas is a result of latent populations which were not destroyed or of invasion from still-infested areas.

I mentioned earlier that the tolerance for DDT in milk had been set at zero by both federal and state food and drug regulations. The enforcement of this tolerance has been progressively tightened, and farmers have had to eliminate every possibility of their cattle feed becoming contaminated with DDT. Under these conditions the spraying of pastures or forage crops with DDT would do serious economic damage to farmers because even a trace of DDT would make their milk unsalable. The pest control people have little choice but to accept as another difficult circumstance the fact that they cannot use DDT in any place where it might contaminate cow feed. At the same time they apparently are not very happy with the more expensive and less effective sevin.

Perhaps the present state of gypsy moth control is revealed most clearly in a resolution passed by the National Association of State Departments of Agriculture at its annual convention in October, 1959. The delegates resolved "that the infested states and the Plant Pest Control Division . . . be urged to eradicate outlying infestations of the gypsy moth as they occur, and to continue to suppress populations in the older areas, thus minimizing the hazard of spread by infestation as well as protecting the eradication work already accomplished until such time as infestation conditions or new methods or approaches make it possible to undertake a permanent solution to the gypsy moth problem."

JUDGMENTS ABOUT GYPSY MOTH CONTROL

We have now considered in some detail the 70-year history of efforts to control the gypsy moth in the United States. We have taken an especially close look at the last 15 years of this effort and at the controversies which have resulted from extensive aerial applications of chemical pesticides. The choices and decisions that were made about gypsy moth control have been spelled out in detail to see whether we can judge them and decide whether they were desirable or not. At various places we have tried to use the tentative criteria of costs and benefits developed earlier in this study as a means of judging the control decisions.

Several things appear evident at this point. Although the tentative cost-benefit criteria seem to be theoretically sound, they obviously are difficult to use in judging real situations. Partly this is because the total information on costs and benefits is usually not available for any particular decision. The exceptions to this seem to be specific decisions regarding relatively small actions that are quite simple in their application and effect. Even here the cost-benefit criteria seem usable only when the costs or the benefits are of such an obviously greater relative magnitude that there is little question as to whether the action is justified or not.

The large and really significant decisions are much harder to test with a cost-benefit analysis. This is partly because of the complexity of the results of these major choices and the difficulty of getting total information on all of the costs and benefits involved. However, the gypsy moth history brings out something more significant. It is evident from this history that no major decision was made entirely at one time. Every decision was influenced by many previous ones and was in itself only a partial decision which was supplemented and in many cases partly offset by other

partial decisions. This appears to be an important characteristic of decision-making in areas such as insect control.

The history of gypsy moth control shows that it is difficult to pick points where one can say "this is good" or "this is bad." For example, can one make a judgment as to whether gypsy moth control in general is desirable or undesirable? No single choice on this question has ever been made. At the beginning it was decided that it would be desirable to try to eradicate the very localized infestation of gypsy moths in Massachusetts. All of the subsequent decisions have dealt with choices of whether one thing or another should be done to expand or contract the then-existing efforts to combat the gypsy moth. Individual choices have been made about doing specific things to the gypsy moth, about using specific control techniques, and about who should do these things and who should pay for them. But the question of whether all gypsy moth control should be carried on or not has really not been faced at any particular time. All of the individual partial decisions about actions or techniques or costs have been made in a framework consisting of the existing programs and historical developments. Thus all of these decisions really have been part of a continuing decision process regarding the gypsy moth. Presumably a grand overall decision could be made to abandon once and for all the entire effort to control the gypsy moth. But it is difficult to conceive that such a decision ever actually would be made.

This seems to indicate that although cost-benefit analysis can provide useful criteria for judging a decision that can be isolated and looked at apart from its environment, in real decision-making situations some other kind of criteria are needed to supplement cost-benefit analysis. The actual decision-maker is not in a position to consider all of the costs and all of the benefits of every individual decision. So what does guide the decisions that he makes? It seems likely that what can be judged usefully is the decision-making process rather than the specific decisions.

In view of this, we will next consider some characteristics of decision-making and then bring together information on the organization which exists in this country to influence and control decisions regarding pest control and pesticides.

THE DECISION MAKING PROCESS

There always have been pests and people probably have always tried to do something about them. Over the years society has faced various kinds of pest problems and has responded to these problems in a variety of ways. Pest control has evolved gradually and has adapted itself to conditions as they changed. Many decisions made in the past have been formalized in laws, in customs, and in organizations designed to deal with pest problems. Current pest control decisions are made against this background of historical development and precedent. This limits materially the kind of decisions that can be made today and simplifies the decision-making process for those people who must make them. In general, current decisions must conform to the pattern which has developed in this evolutionary process. Of course, none of the previous decisions are necessarily permanent but those which have become well established are not readily changed.

An attitude has developed that pest control is a social problem that cannot be left to the decisions of individuals who may disregard the effect of their actions on others. There is general agreement that governments must take actions of various kinds to ensure that pest control will serve the public interest. This public action has taken two forms. One consists of laws regulating activities in pest control, such as those regulating the use of chemical pesticides. The other is organized government activity in the control field itself.

Closely related to this recognition of the need for government action is the fact that individuals commonly do not try to control pests entirely by themselves. Most pest control is not a process in which every individual affected by the pest attempts to act against it himself. Instead, the affected individuals have delegated much of the responsibility for pest control actions to other persons. One form this has taken is delegation of authority to legislatures and to various government organizations. Much current decision-making no longer rests with the individuals affected by the pests but rather with their delegated representatives in the legislatures or in government agencies. Another form is the delegation of specific functions in pest control to individuals or organizations. These are functions like research on pesticides, regulation of pesticide use, and the application of pesticides. Often the individual functions are delegated to different people. These people may be members of various government agencies or may be private individuals, companies, or organizations. When governments take actions in pest control they also commonly delegate various functions to different divisions and branches of the governmental organization.

The overall effect of this delegation of authority and of function is that many different people and agencies are involved in the decisions which are made regarding pest control. Decision-making is fragmented, and no one person or organization ordinarily makes major decisions by himself. Some of the decisions are made by individuals regarding their own actions, some by legislatures regarding the actions of individuals and government bureaus, and some by government and private agencies acting to carry out functions that have been delegated to them. The pest control actions which are going on at any particular time are a result of many separate decisions made by many different people.

Because decision-making is so fragmented, the ways in which the authority and responsibility for making these decisions are delegated to the respective individuals and organizations may have a critical bearing on whether the resulting decisions are desirable or not. The delegation of specific functions permits the development of specialized groups which are expert in the functions they perform. This generally leads to

greater efficiency. But all of the functions must fit together into the overall pest-control picture. If individual specialists concentrate too narrowly on their own functions, they may not supplement each other properly and overall efficiency may be low. Co-ordination of these fragmented decisions is therefore quite important. This co-ordination actually is brought about in a variety of ways but the results are necessarily compromises. That is, all of the individuals who are in a position to make decisions regarding a particular action must somehow reconcile their individual decisions before an overall decision can be made and action can proceed. This necessity to compromise limits the possibility that programs may develop which are aimed at one particular goal to the exclusion of all others.

A final characteristic of decision-making in pest control is that individuals with common economic or other interests join together and tend to act as groups rather than as individuals. The way in which these groups function exerts a considerable influence on the decisions that eventually are made.

With this general pattern of decision-making in mind, let us now look at the process through which decisions regarding pest control actually are made in the United States. First we will consider the decisions that have been written down in law and which thus form a legal basis for pest control. These laws establish a basic delegation of responsibility by the legislatures and give authority to various government organizations to take certain pest control actions. Then we will consider the major interest groupings that are involved in insect control with chemicals. These will not necessarily always be organized groups, but will be classes of individuals, organizations, and groups which have a common interest in some particular aspect of insect control. Finally we will look at the actual process through which decisions are made regarding current pest control actions. This will involve the administrative organization of the major pest control agencies, the lines of authority within those agencies, and the checks and controls placed on the decisions made by the individuals who represent those agencies in specific pest control actions.

LEGAL BASIS FOR INSECT CONTROL WITH CHEMICAL

The people of the United States, acting through their representatives in Congress, have made some basic decisions about the control of insect pests and the use of chemical pesticides. They have put down in writing certain value judgments which set the stage for all further choices in this area.

The first decision was that some organisms are pests and should be controlled. It was then decided that the responsibility for this control should be delegated to the Secretary of Agriculture. This is spelled out in the basic law, which was passed by Congress in 1937. Section 148, Title 7 of the U. S. Code reads in part as follows: "The Secretary of Agriculture, in co-operation with authorities of the states concerned, organizations, or individuals, is authorized and directed to apply such methods for the control of incipient or emergency outbreaks of insect pests or plant diseases . . . as may be necessary." A decision was made by Congress that outbreaks of pests must be controlled. This law tells the secretary to take action (note the word "directed") in case of such outbreaks. And it was further decided that such action should be co-operative with the other people concerned.

A later law, passed by Congress in 1944 and written down in Section 147a of Title 7, U. S. Code, reads in part as follows: "The Secretary of Agriculture either independently, or in co-operation . . . is authorized to carry out operations or measures to eradicate, suppress, control, or to prevent or retard the spread of insect pests, plant diseases, and nematodes. . ." This was a somewhat broader decision. It permits the secretary to act independently. It authorizes him to take actions of various kinds against pests at any time and not just in case of an outbreak. It recognizes the different types of insect pests discussed earlier in this report and indicates public approval of action against insects which are pests even when epidemic conditions do not exist.

A still more specific decision was made in 1947 in the form of the Forest Pest Control Act. Section 594 of Title 16, U. S. Code reads in part: "The Secretary of Agriculture is authorized either directly or in co-operation . . . to conduct surveys on any forest lands to detect and appraise infestations of forest insect pests and tree diseases, to determine the measures which should be applied on such lands in order to prevent, retard, control, suppress, or eradicate incipient, threatening, potential, or emergency outbreaks of such . . . pests, and to plan, organize, direct, and carry out such measures as he may deem necessary to accomplish the objectives and purposes of . . . this title." This specifically recognizes the value of forests to the public.

A second decision was that the economic poisons used to control pests are hazardous and that some actions should be taken to reduce the hazard. Two laws dealing with different aspects of pesticide use have been established to protect people from these poisons.

The first is the federal Insecticide, Fungicide, and Rodenticide Act, which was passed in its present form in 1947 but is based on a law passed in 1910. The purpose of this act is to regulate the marketing—but not the use—of pesticides. It first requires that any economic poison which moves in interstate commerce must be registered with the Secretary of Agriculture. The request for registration must include—among other things—a statement of all claims to be made for the pesticide and the directions that will be given for its use. The pesticide will not be registered unless it

appears to warrant all the claims made for it and unless the directions for use are satisfactory. The act also specifies that any pesticide sold in interstate commerce must bear a label on which certain required information is clearly stated. In the case of poisons which are highly toxic to man this information must include a skull and crossbones, the word "poison" prominently in red, and a statement of the antidote for the poison. A pesticide will not be registered unless a satisfactory label is submitted for it. Finally, the act specifies that pesticides can be transported and sold only in the original unbroken package. There are other minor provisions and regulations but these are the major features.

This act clearly is intended to protect pesticide users. It indicates a general value judgment that the health of people is more important than the control of pests. The required label information helps the user make rational decisions as to when and where to use a particular pesticide. All claims about the effectiveness of the chemical must be substantiated before it will be registered. So the manufacturer has to provide some of the basic information needed to compare costs and benefits.

It is important to note that the Insecticide, Fungicide, and Rodenticide Act does not place any restrictions on the *use* of chemical pesticides. A farmer who buys some particular insecticide may apply it in any way that pleases him. The required label warns him of the hazard and suggests how and for what purposes he should use the contents of the container. But the act does not require the user to protect other animals or people when using the pesticide.

Some of the people who might be harmed by pesticides are given protection by the Miller Amendment of 1954 to the Food, Drug, and Cosmetic Act. This requires the Secretary of Health, Education, and Welfare to establish tolerances for pesticide chemicals in or on raw agricultural commodities. Any chemical is automatically deemed to be unsafe until the Secretary either has prescribed a tolerance for it or else has exempted it from this requirement. It is illegal to transport or sell in interstate commerce any raw agricultural commodity which contains residues of an unsafe chemical or an amount of residue greater than the tolerance prescribed for a safe chemical. The secretary is permitted to establish the tolerance at zero level if he feels this is necessary, and he has done this for all pesticides in milk.

The Miller Amendment places definite restrictions on the pesticides which a farmer can use on his crops. He is limited to those pesticides and rates of application that will not leave residues on his produce greater than the established tolerances. This law reflects a strong value judgment that health is important to the public interest and that pesticides must be used in such a way as to avoid hazards to health. It delegates some subsidiary decision-making to the secretary in this respect. He is instructed when establishing tolerances to consider the "necessity for the production of an adequate, wholesome, and economical food supply" and "the other ways in which the consumer may be affected by the same pesticide chemical or by related substances that are poisonous or deleterious." He is to decide what would be in the public interest, but human health is to carry a heavy weight in this decision.

These laws represent a basic decision that it is in the public interest to control pests and to do this with chemical pesticides but that it is essential to protect human health as much as possible in the process. The federal laws are paralleled in most states by local legislation to take care of intrastate problems. The states have authorized some official—his title and position varies—to control pests within his state. Most states have an economic poisons law of some kind and many require registration. Many also have food and drug laws which extend the provisions of the federal law to intrastate commerce. These many decisions dealing with fragments of the national problem fit together into a general decision to control pests but to control the use of pesticides at the same time.

GROUPS INVOLVED IN CONTROL WITH CHEMICALS

Even if we limit our attention to insect control alone we find a surprising number of individuals, organizations, and groups who are concerned in one way or another and most of whom take an active part in decision-making. Special attention will be given to those organizations or groups which individually play a major role in pest control.

THE PESTICIDE USERS

Probably the key group in the pesticide problem is that which consists of the individuals and organizations who actively carry on insect control programs. (Others often act as agents of this group in the actual application of the pesticides but do not make the controlling decisions. They will be considered later.) This group recognizes a need for insect control and initiates the decisions which lead to action. To the poorly informed observer it might appear that these people act independently, make the critical choices themselves, and should bear the full responsibility for the results of their actions. Some of the more emotional statements about the use of pesticides seem to assume that this is so. In actual fact, although these people are the prime movers in the pesticide programs, a great many others participate in the decision-making, as we will see.

A larger quantity of pesticides is applied by farmers, other individuals, and private companies than by all of the public agencies together. Most of these applications involve relatively small areas although sometimes these efforts are pooled—as in grasshopper control—to cover extensive areas. In general, the actions taken by this group affect only their own properties. The institution of private property is so firmly estab-

lished in our society that few questions seem to have been raised about the use of pesticides by farmers on their own farms. Relatively heavy amounts of insecticides are applied to field crops and orchards and often the application is repeated a number of times during the season. Since practically all farmers use insecticides on their crops, the total amount of chemical applied in any one area, such as a county, during a year is very large. But the few objections seem to have come from neighbors affected by spray that drifted onto their property.

The Secretary of Agriculture has delegated his responsibility for acting against pests to two agencies in the Department of Agriculture. The Forest Service is responsible for the control of forest pests under the Forest Pest Control Act and the Plant Pest Control Division of the Agricultural Research Service is responsible for the control of all other plant pests.

The Plant Pest Control Division has primary responsibility for introduced insect pests, although it also controls some of the native insects which periodically become epidemic, such as grasshoppers and the Mormon cricket. In its campaign against introduced pests, the division uses quarantines and both eradication and control techniques. When a new pest finds its way into this country, a quarantine is established to try to keep the insect from spreading. A strenuous effort is then made to eradicate the pest through the use of insecticides and any other feasible means. This proved successful with the Mediterranean fruit fly in Florida. Other introduced pests, like the Japanese beetle, have been in this country a long time and have spread over a wide area. Some of these are still confined by quarantine, and the division feels they might now be eradicated with the newly-developed insecticides and aerial spraying techniques.

The Plant Pest Control Division's emphasis on eradication is significant. It is an important distinction between this division's program and that of the Forest Service, which up to now has not attempted to eradicate any forest insect. An eradication program differs materially from a control program. To be successful, it must kill *all* of the insects. The damage being done in any locality is not relevant to the program. The insect must be wiped out wherever it occurs, regardless of the numbers present. If the eradication effort is successful, that particular problem is ended. Expensive quarantine and control programs can be terminated, and all that remains is continuous vigilance to prevent the insect from entering the country again. Plant Pest Control also maintains quarantines on some insects that it is not trying to eradicate and conducts control programs against some native or well-established pests.

Most of the Plant Pest Control Division's work is done in co-operation with the states. State quarantines to prevent the spread of an insect within the state are tied in with the federal quarantines aimed at interstate movement. Control and eradication efforts are usually joint state-federal programs or are closely co-ordinated, but some programs are entirely federal. Financial assistance is made available to the states on a cost-sharing basis with each agency administering its own funds. This federal participation is justified by the fact that quarantine and control work in an infested state will usually benefit other states by protecting them from invasion by the pest. The division also co-operates with the states in a plant pest survey. This is intended to give current information on pest conditions so that farmers and control organizations may plan efficiently and also may detect a newly-introduced pest as promptly as possible.

The United States Forest Service is responsible for carrying out the federal role in control of all forest pests except the gypsy moth. Since the gypsy moth is an introduced pest and is under quarantine, it has been assigned to the Plant Pest Control Division which has a quarantine organization. The Forest Service primarily is concerned with suppressing native pests that occasionally become epidemic rather than eradication of introduced pests.

The Forest Service engages in insect control in a dual capacity. It provides leadership, co-ordination, and technical assistance for control work on any forest lands. On the national forests and other federal lands under its own jurisdiction, the Forest Service also carries on the actual operations. Insect control on other federal lands may be done by the agency having jurisdiction, with technical and financial assistance from the Forest Service. Or it may be done by the Forest Service itself, acting for the other federal agency. Actual control work on state and private forest lands is usually done by the responsible state agency with technical and financial assistance from the Forest Service.

There is a distinct division of responsibility for decision-making in Forest Service pest control programs. Its Division of Forest Pest Control administers the funds made available under the Forest Pest Control Act. This division must be convinced that a program is desirable and that anticipated benefits exceed control costs before it will allocate money for it. But it does not do the actual control work itself. So the operating agency—the national forest administrative organization, the administrators of other federal lands, the state agency, or the private owner—must also be convinced that the program is desirable. The operating agency is usually in a position to see more clearly all of the effects of the action and perhaps is less likely to confuse the control of insects with the real ultimate goals. The affected groups work closely together and are in contact with each other much of the time. So the decision-making is not as mechanically separated as an organization chart might suggest.

The Forest Service is a highly decentralized organization. It operates through ten regional offices, and many decisions are made at the regional level. The Forest Pest Control unit in each regional office works directly with the states and private owners in its region. The regional offices of the Forest Service are in frequent contact with the states on a variety of other programs, and the overall relationships appear to be

quite close. The administration of the national forests is even more decentralized. Each forest is in charge of a supervisor who is responsible to the regional forester. The forests in turn are divided into ranger districts in charge of district rangers who are responsible to the supervisor. Many recommendations regarding pest control are made by the supervisors and rangers who have an intimate knowledge of local conditions.

The states delegate the responsibility for insect control within their boundaries to one or more of their own agencies. In many states there is a bureau or division of plant industry in the state department of agriculture which is responsible for agricultural pests. Many states place the responsibility for control of forest pests on the state department of forestry or conservation. Some delegate responsibility to a state entomologist for the control of some or all insects. There is no definite pattern but some provision is made for handling intrastate insect problems in every state.

Much of the state pest control work is done in cooperation with one of the federal agencies. But some pests are not considered to be of sufficient interstate importance to justify federal financial support, so many states carry on insect control programs of their own. Frequently they receive technical advice from the federal agencies on these programs even though they are not co-operative in the financial sense. There is a close relationship between pest control workers that seems to cross state and agency boundaries with little difficulty. The activities of the states in insect control are actually broader than those of the federal government for they engage in—or co-operate with minor political subdivisions in—mosquito control, protection of street and shade trees, and similar activities.

A general policy has developed that the states are responsible for the protection of private property and that the federal government acts only through the states in protecting such property. The federal agencies take literally the provision in the law that the cooperating state shall be responsible for the authority necessary to carry out pest control activities on nonfederal lands within the boundaries of that state. It seems likely that in an emergency situation the federal government could legally take action to control a pest which threatened to spread to adjoining states if the state where the pest occurred refused to act. However, in the programs now under way the federal agencies seem to lean over backward to leave final decisions to the states.

THE PESTICIDE REGULATORS

The use of pesticides is restricted by state and federal laws which spell out public policies regarding situations where human health might be endangered by insect control. The basic decisions thus have been made for the agencies that enforce these laws. Their assigned task is to implement these policies. Of course, they still have to make decisions about the means to be used in doing this. And to some extent they make choices which affect pesticide use by their interpretation of the laws.

Enforcement of the federal Insecticide, Fungicide, and Rodenticide Act has been delegated to the Plant Pest Control Division of the Agricultural Research Service. The division's regulatory activities consist of two parts. First, it reviews the labeling of products to determine whether the labels describe accurately what the product is capable of doing and the mode of use that will be safe. This is usually done at the time the chemical is considered for registration. Second, it samples interstate shipments of registered pesticides to see whether they are properly labeled and otherwise in compliance with the law. If necessary it takes legal action against products shipped illegally or shippers who violate the law. The federal government can regulate directly only those pesticides which move in interstate commerce. But the decision co-operates closely with the various state officials who enforce the state pesticide laws. An effort is made to achieve uniformity in the administration of the federal and state laws.

The Plant Pest Control Division also has responsibilities in connection with the Pesticide Chemicals Residue Amendment (Miller Amendment) to the federal Food, Drug, and Cosmetic Act. This division must certify the utility of any chemical for which a tolerance is sought. It also tells the Food and Drug Administration how much residue is likely to remain in or on a crop after it has been treated with this chemical in accordance with the proposed directions. This means that many decisions about the restriction of pesticide use are made in the Plant Pest Control Division because it is here that much of the information about a specific pesticide is evaluated and checked.

The Food and Drug Administration of the Department of Health, Education and Welfare is primarily responsible for the enforcement of the Pesticide Chemicals Residue Amendment. This is the organization which establishes the tolerances for pesticide residues on raw agricultural commodities. The Food and Drug Administration conducts intensive tests of the effects produced on rats and other animals when the chemical pesticide in question is included in their diet. It aims to arrive at an amount of intake that shows no physiological effects whatever on the test animals. The Food and Drug Administration is handicapped in its work by the fact that it cannot test these chemicals on human beings. So it is forced to estimate the effect on the test animals. A large allowance for error is included in these estimates and the government pharmacologists feel that the estimates are generally quite conservative.

In establishing a tolerance, the Food and Drug Administration uses two kinds of data: results from the feeding tests on animals and information on the amount of residue left on a crop which has been treated with the minimum amount of the pesticide that will control the insect. The tolerance is set at whichever amount of residue is least. This means that for many crops and chemicals the legal tolerance is an amount of residue far less than that which shows any indication of physiological effects on animals.

The Food and Drug Administration does not attempt to make a complete check for residues on all produce moving in interstate traffic. That would be an impossible undertaking. Instead it depends on spot checks and on following up suggested leads as to possible violations. This regulatory work is tied in closely with the programs of the similar state organizations.

Most states have agencies which regulate the marketing of pesticides and control the amounts of residue on agricultural crops. Their exact form varies from

state to state. But wherever they exist, they are closely integrated with the federal agencies. This leads to a uniform approach to a problem that is just as serious within a state as it is when it crosses state lines.

Still another federal agency is concerned about the use of pesticides, although it has no regulatory work under way as yet. This is the Public Health Service and in particular its Division of Sanitary Engineering Services. Under the Federal Water Pollution Control Act, the Public Health Service is charged with maintaining water quality. It is directly responsible for the water in interstate streams and also works closely with state pollution organizations. The Public Health Service is concerned with any damage that occurs through water whether it be to humans or to other forms of life. It sets standards for water quality and at the present time is revising them to consider new contaminants. Among these are pesticides which have begun to appear in measurable quantity in some streams. Although the amounts found so far are very small, the Public Health Service is trying to anticipate a situation in which the pesticide content of water might reach dangerous proportions.

GROUPS INFLUENCING PESTICIDE USE

In addition to the groups which have legal regulatory responsibilities concerning pesticides, a number of others are working actively to influence the use of these chemicals. These people are not in a position to make decisions themselves about the use of insecticides. But by their nature and position they can exert an influence on the kinds of choices that are made and often are able to guide these choices effectively.

Perhaps the most obvious of these is the Extension Service of the Department of Agriculture. This organization—which is run co-operatively by the states and the federal government—has closer relations with farmers than any other public agency. Through its system of county agents it reaches individual farmers directly and carries on a continuous program of education and assistance to farm people. Among many other activities, it advises farmers on their use of pesticides. The latest recommendations as to the type of insecticide to use, the rate at which to apply it, and the precautions to observe in protecting health are brought immediately to the farm users through publications, meetings, and personal farm visits by the county agents.

The Extension Service would be useful if it did no more than provide individuals who use pesticides on their farms with information to help them make rational decisions. But it goes further than this. It makes specific recommendations which are closely followed by farmers. A good example is a publication in the Agriculture Handbook series called "Insecticide Recommendations of the Entomology Research Division for the Control of Insects Attacking Crops and Livestock." This handbook is revised annually to provide the latest information for a particular growing season. It is prepared mainly by the Entomology Research Division of the Agricultural Research Service but with the help of the Pesticide Regulation Section of the Plant Pest Control Division. The handbook gives specific recommendations for each crop and for each insect that attacks it. These tell the farmer exactly what to do in order to control the pest and at the same time stay within the legal residue tolerance and protect himself and his livestock from damage. When a farmer follows these recommendations he is delegating a considerable part of the decision-making process to the well-informed personnel of the Agricultural Research and Extension Services.

Three different groups concerned with the welfare of wildlife are in a position to actively influence pesticide decisions. The most direct tie in is that of the Wildlife Division of the Forest Service. This division occupies a staff position from which it advises the administrative officers of the national forests on the management of the wildlife resources of those forests. In this position it is able to point out the possible deleterious effects of forest insect control programs and to advise modifications which might reduce wildlife losses. This division also has a chance to pass on requests for insect control funds under the Forest Pest Control Act, so its influence is not restricted to programs on federal lands.

The forest insect control problem is simplified somewhat by the traditional multiple-use philosophy of the Forest Service. National forest administrators—and Forest Service officials generally—tend to think of forest management in terms of all products: timber, water, game, fish, recreation, and aesthetic values. The effect of pesticide programs on the animals in the forest is therefore likely to be considered early in the planning.

The federal Fish and Wildlife Service also has an active role in pesticide use. This service has been concerned for a long time about the widespread application of pesticides to wild areas. It has sent observers into the field on many programs and has co-operated with the action agencies in planning and in the development of policies. Recently a definite liaison arrangement has been established between Fish and Wildlife and both the Plant Pest Control Division and the Forest Service. This places the Fish and Wildlife Service in a strong position to influence the decisions made by those two organizations. In fact, it may be drawn in as a consultant on much of the actual decision-making.

Finally, the state fish and game departments exert a certain amount of influence on the use of pesticides within their states. In Connecticut any aerial application of pesticides or fertilizers must be approved in advance by an Administrative Policy Committee which consists of one member each from the Board of Fisheries and Game, the Department of Aeronautics, the Agricultural Experiment Station, and the State Health Department. In most other states, the position of the state fish and game agency in decision-making is not designated so explicitly by law. But these de-

partments universally enjoy strong political support within their states and are able to exert considerable pressure on other state agencies. They frequently have been brought into spraying programs as observers, and their guidance has been sought in the planning of the more extensive programs.

Three other groups should be mentioned briefly as examples of the extent to which decision-making about pesticides is fragmented. In the various parts of the country, the state officials responsible for agriculture, nurseries, and similar activities based on vegetation are banded together in regional plant boards. These boards are concerned with the control of various pests and the use of pesticides. They have provided a medium for the co-ordination of state efforts and for influencing federal appropriations and programs. A similar type of organization exists in the local or regional Forest Pest Councils. These informal councils are composed of representatives of all agencies interested in forest pest problems. They provide a means for pooling ideas and for taking co-ordinated action on specific problems or in the development of policies. Finally, there is the Council of State Governments, which is an organization designed to help the state pool their problems and co-ordinate their efforts. The Council's main activity in this area has been in providing help to states that were considering legislation to regulate the marketing of pesticides or the custom application of pesticides. However, it also has a Regional Co-ordinating Committee on Gypsy Moth Control which has had a material influence on the policies and programs dealing with this insect.

PRODUCERS OF FACTS ABOUT PESTICIDES

Rational decisions in insect control must be based on knowledge about the factual questions involved. Complete answers to many of these questions obviously are not available at present. So we may well ask what is being done to provide this essential prerequisite for satisfactory insect control and pesticide use? There are in fact many organizations working actively on these questions. They may not be doing as much as would be desirable but they do have programs under way, and presumably this research could be expanded considerably without adding any new organizations.

The most numerous individual organizations are the state agricultural experiment stations. These stations have studied the insect pests of their individual states for many years. Through the Extension Service and the state agricultural colleges, the state experiment stations are in close touch with people who have insect problems. They can keep their research directed at currently pressing problems and are able to get their results into pilot testing use quickly. Much of their work is done in co-operation with various federal agencies. The research at state experiment stations is mostly limited to methods of controlling insects. This often involves fundamental studies of the life histories and other characteristics of the insects. But the emphasis is on control techniques with only limited attention to the effect of these on other forms of life.

Another widespread research effort is that of the experiment stations operated by the Forest Service. These regional experiment stations each conduct an active program of research on the forest insect and disease pests of their region. (It is interesting to note that the primary responsibility for research on the gypsy moth rests with the Forest Service, although the control of that pest is assigned to the Agricultural Research Service.) Most forest experiment stations are located where they can take advantage of the facilities of a modern university. The co-operative relationships—which seem to be so typical of pest control—show up again here, as much Forest Service research effort is in co-operation with colleges and other experiment stations. The primary emphasis of the forest experiment station research is on control technique.

Most colleges of any size have at least one entomologist on their faculties and usually have some research under way. Their research ordinarily is more concerned with the insects than with the damage they do. The studies are likely to be of a fundamental nature and to deal with classification, life histories, and the biological characteristics of insects. Such studies produce much basic information needed by the economic entomologists for their applied work. Many colleges also do contract research for government agencies or carry on studies under grants from such agencies. This work is often oriented toward some practical problem of immediate concern to the control organizations. Some colleges also are doing a limited amount of research on the effects of pesticides on other organisms, including man. The number of grants and other co-operative arrangements with colleges for work of this kind have been increasing in recent years. The colleges seem well suited to do the kind of fundamental research that is needed, and it is unlikely that their efforts will expand in the future.

The Entomology Research Division of the Agricultural Research Service has the primary federal responsibility for research on non-forest insects. They take their job to be that of developing satisfactory control techniques for farmers and other people to use against insects. The division does a certain amount of testing, mostly as a service to the agencies which register pesticides and establish tolerances for them. It feels that this type of work should really be done by the manufacturers, except for some checking, and that the division's efforts should be directed almost entirely toward methods of control. This division is now actively engaged in studies of insect diseases and other biological controls and would like to expand this kind of work.

Both the Plant Pest Control Division and the operating branch of the Forest Service carry on investigations of their own. Plant Pest Control has an active methods-improvement program which seeks to find better techniques of application, better methods of testing chemicals, and so on. They sponsor research at the colleges on problems of immediate concern in their control programs. However, there is no definite policy in either case of earmarking part of the funds appropriated for a particular control program to be used for research in connection with that program.

The Fish and Wildlife Service has under way a considerable program to determine the effects of pesticide chemicals on wild animals. The service has been doing some work on this problem for years but its program was given impetus in 1958 when Congress specifically directed the service to study the relations of pesticide use to wildlife. The appropriations made thus far are

considered quite inadequate for research of this complexity. But they have enabled the service to make a start and to lay the basis for expanded work in the future. Most of the research thus far has been on birds in captivity—quail, pheasants, and mallard ducks. These studies have aimed at determining how much pesticide could be in a bird's diet without affecting normal survival and how much would cause a reduction in reproductive activity. The service also has some field studies under way. It feels that an adequate study should involve laboratory tests, then field tests over a period of at least a year, and finally pilot plant tests on a scale similar to that used in actual applications.

The Food and Drug Administration's program consists mainly of the testing necessary to establish tolerances for residues on agricultural commodities. However, in the course of this testing, the Pharmacology Division develops useful information about the physiological effects of these pesticide chemicals on animals. In contrast to the Fish and Wildlife Service's program, Food and Drug's research is done entirely on mammals. The work of each organization thus supplements that of the other although there does not seem to be a close relationship between the two groups.

The Public Health Service is doing research in two areas of the pesticide problem. The Division of Communicable Disease Control through its Toxicology Section is conducting research at Savannah, Georgia, and Wenatchee, Washington, on the effects of pesticides on human beings. This is a difficult kind of research for it is almost impossible to use humans as test specimens in controlled experiments. However, progress has been made in testing the effects of pesticide chemicals in the diet and of exposure to these chemicals during application or manufacture. The Division of Sanitary Engineering Services has a research center in Cincinnati, Ohio, which has done considerable work on the effects of pesticides on fish and other aquatic life. The Water Supply and Water Pollution Control Branch of this division is also planning studies of the pollution that may result from large-scale pesticide applications such as those used in the fire ant eradication program.

Finally, the chemical companies which manufacture and sell pesticides carry on research programs themselves. It is not enough for these companies to learn through screening and testing that certain chemicals will kill insects. Such chemicals must be registered before they can be sold. This requires positive proof of their effectiveness against insects, reliable information on their toxicity to other forms of life, and information on the amounts and persistence of toxic residues. These companies co-operate with the public agencies in research and also sponsor a considerable amount of research by colleges and private laboratories. The public has placed on these companies the responsibility for providing the basic facts about their products, and the companies do not seem to object to this.

There undoubtedly are other groups carrying on research relevant to the pesticide problem. But this should be enough to show that a considerable effort is being made to obtain the information needed for rational choices in this field. This effort has been expanding in recent years and seems certain to grow still more.

PESTICIDE MANUFACTURERS

A large number of private firms make a business of manufacturing and selling pesticides. Many critical decisions about pesticide use are made by these firms.

Chemical companies which manufacture pesticides usually produce a number of other products, but pesticides form a significant part of their business. This is a competitive field and there is pressure on these companies to develop new and superior pesticides in order to stay ahead of their competitors. They put considerable effort into research and the testing of promising new products. It has been estimated that it costs between one and two million dollars to develop a successful new pesticide and to place it on the market. The possible compounds which are produced by the research chemists must first be biologically evaluated. Then a feasible means of commercial synthesis must be developed, the product must be tested for field performance, the necessary data must be developed on effectiveness and toxicity to other animals to qualify for registration, and finally the pesticide must be demonstrated and advertised to its potential users. This high cost of development puts a premium on producing chemicals which have a wide range of effectiveness and which will be used in large quantities. It tends to discourage the development of specific chemicals for individual species of insects and individual crops because, although the developmental costs of such specifics will be high, the potential sales will be limited. The stringent and consequently expensive testing required by the laws designed to make pesticides safe may be an unintentional handicap to the development of new chemicals which in the long run might be safer.

The chemical manufacturers have organized the National Agricultural Chemicals Association to act for their industry. This association has been much concerned with the criticisms leveled against pesticides. It works with the state and federal regulatory agencies as the representative of its members. And it carries on an active safety program of its own.

COMMERCIAL APPLICATORS OF PESTICIDES

Aerial application of pesticides to farms and other areas is contracted by some 2,000 flying firms. These are the survivors of a large group who entered the business following World War II. Many of the original people were poorly equipped, untrained in chemical application, and operating on a shoestring. The resulting slipshod work was detrimental to the industry as a whole. The National Aviation Trades Asso-

ciation has worked to improve this situation. Its members adopted a Code of Requirements for Members Engaging in Commercial Aerial Spraying, Dusting or Seeding Operations in 1949 and this code is being revised to make it stricter. The association has encouraged the development of short courses at state colleges where operators are instructed in insect identification and life histories, the various chemicals and methods of applying them, and the state recommendations for insect control. Most operators have now attended some of these courses and are able to do more than merely fly the spray planes.

The National Aviation Trades Association considers it important that contracts for extensive aerial spraying programs be placed on a qualified basis and not merely on the lowest bid. It has under consideration a certification system for aerial applicators which would be based on the operator's having the necessary equipment, the necessary personnel, and the necessary financial resources. The association feels that some objections to aerial spraying programs could be overcome if only highly qualified firms engaged in such operations. The industry and its association are actively trying to find the answers to some of the questions that arise in the application of pesticides to extensive areas from the air.

Many landscaping, tree expert, and similar firms engage in pesticide applications along with their other activities. Often the property owner delegates to these firms much of the decision-making about pesticide application. There is wide variation in their qualifications for making the kinds of decisions that are involved. Some have entomologists, horticulturists, or people of similar scientific training on their staffs. Other firms know only what they have learned by experience, reading, and perhaps attending short courses. Most states try to insure some minimum level of competence by requiring licenses for people doing this kind of work. The individual areas treated by these firms are usually quite small, but the total area treated during a year must be large.

OUTSIDERS' CONCERN OVER PESTICIDES

All of the people, organizations, and groups discussed thus far have a direct and active position in insect control or the use of pesticides. They can take a direct part in the making of decisions. There are other groups and organizations interested in insect control and concerned about pesticides but who do not participate actively in the decision-making. These groups are not without influence on the decisions, but they have to exert their influence indirectly. They do this in a variety of ways ranging from the calm presentation of factual and well-grounded arguments at public hearings to highly emotional and inflammatory allegations in the public press.

One of the more vocal of these organizations has been the National Audubon Society. Although this group is primarily concerned with birds, it has an interest in the welfare of other wildlife and, in the case of pesticides, has expressed a concern for man. It has been one of the leaders in the campaign against aerial spraying of pesticides and has called for immediate termination of all large-scale spraying activity. Along with this it has suggested that a twenty-five million dollar a year research program be instituted and maintained until the answers to the effects of all pesticides on all animals are obtained. The society has not hesitated to use exaggeration and "scare" statements in its attempts to make its points. And it has attempted to organize pressure on Congress to do something to reduce the amount of aerial spraying.

The state wildlife federations and their national organization, the National Wildlife Federation, have taken a strong stand against the use of pesticides and particularly against aerial spraying. The national federation has given an opportunity for both sides to state their case at its annual meetings but its own attitude on this subject does not appear to have been changed. Some of the state federations have produced bitter accusations against the pest control organizations and have used evidence the validity of which appears questionable. This approach does not seem conducive to a satisfactory solution of the problem. The Wildlife Management Institute has taken a more reasonable and scientific attitude. It has objected to the effects of pesticides on wildlife but has called for more research to develop the facts about the side effects of widespread application of these chemicals.

Many other professional, scientific, and conservation groups have gone on record with their views on this subject. As might be expected, the agriculture, forestry, and similar groups with allied interests have emphasized the damage caused by insects and the need for using insecticides. The nature, wildlife, organic gardener, and similar groups have emphasized the side effects of the pesticides and usually have simply ignored the insect problem. On the whole, these groups have served a useful function in drawing attention to the dangers of pesticides and providing opportunities for publication and discussion of the many facets of this problem.

HOW PEST CONTROL DECISIONS ARE MADE

In some writings criticizing the pesticide programs there appear terms like "indiscriminate spraying" and "ill-advised, hastily conceived, poorly planned." One could get the impression from such statements that various bureaucrats are able to make offhand decisions to spray large areas on the basis of their own snap judgments. The information presented so far should make the reader skeptical that such is the case. But the facts will become clearer if we follow in some detail the process through which these decisions are made. This is not an attempt to "whitewash" the agencies that conduct pesticide programs. Decisions have been made which are at least questionable and may even have been "wrong." There is room for im-

provement. But a more elaborate machinery exists to control the making of these decisions than most people realize.

FOREST SERVICE PEST CONTROL

The Forest Service follows detailed procedures in its pest control planning and programs. Pains are taken to leave nothing to chance. The Forest Service Manual and Forest Service Handbook contain detailed statements of policy, assignment of responsibility, and approved procedures for all service activities. These have been worked out in conference by committees representing all branches of the Forest Service that are affected. In addition, written organization and work plans, progress and completion reports, and evaluations by inspectors are available for most projects of any size. This makes it possible to get definite information on what the Forest Service has done and plans to do.

The procedure followed on insect control is as follows: When federal assistance is desired, the request for action must originate with the land manager. On the national forests this is the forest supervisor. On other federal lands it starts with the local supervisor and is approved by his superiors. On private or state lands, the request must come through the state forestry department or similar state agency. This land manager must estimate the amount of damage that the pest will do unless controlled. His request for action, supported by the damage estimate, is sent to the regional forester. From there it goes to the forest experiment station covering that area. The experiment station makes a biological evaluation to determine (1) what physical damage the insect is doing, (2) what the probable future trend of the outbreak is likely to be, (3) whether there is any feasible means of controlling the insect, and (4) what benefits might be expected from control. On the basis of this information, the station then comments on the need for the control program from the insect biology viewpoint.

If the experiment station feels that a control program is biologically advisable, the regional office then studies the proposal to compare the forest values threatened with the costs of control and any hazard to wildlife or other values. A decision is made here on the specific kind of program to recommend—forest cultural measures, logging, biological control, use of pesticides, or some combination of these. Specialists in the regional office on wildlife, recreation, and timber management usually are consulted on this decision. If the proposal is approved in the regional office, a request for funds is then submitted to the Washington office accompanied by a complete economic and biologic justification and the recommendations of local forest pest action committees.

The Department of Agriculture has established a policy of not paying more than one-third of pest control costs on non-federal lands. The general Forest Service policy has been to limit federal participation to one-fourth of the cost. This means that private owners or states and local governmental units must be prepared to pay most of the cost of any program they propose. A common arrangement is for the federal government to pay one-fourth of the cost and for the state and the private owners to split the remaining cost between them. This provision alone causes both private owners and states to consider seriously any pest control decision before they assume the financial burden involved. A request to the Washington office for funds to conduct a control program on state or private lands must be accompanied by a firm commitment by these other owners to pay their share of the cost.

A small part of the Forest Pest Control Act Funds is allotted directly to the regional foresters to cover administrative expenses, but most of this money is allocated to specific programs as they are approved in the Washington office. If the regional forester has sufficient uncommitted funds, he may approve himself a control project which entails less than $10,000 in federal funds. Any proposal involving more than $10,000 of federal funds must be approved in Washington. This means that all large programs have Washington office approval. In Washington, most of the study and decision to approve a proposed program takes place in the Forest Pest Control Division. The Wildlife, Timber Management, Insect and Disease Research, and other divisions are consulted. In the case of large or questionable programs the decision is made by a group representing the various divisions concerned. Liaison is maintained with the Fish and Wildlife Service and other interested agencies, and their advice is requested on difficult decisions. Theoretically, in case of a stalemate between the various staff divisions the final decision may be passed up to the assistant chief or even to the chief of the Forest Service. In actuality, a stalemate probably would raise enough doubts that the project would be disapproved without calling on a superior official.

A higher-level decision is made when Congress appropriates funds for administration of the Forest Pest Control Act. The Forest Service includes in its budget each year an item for forest pest control based on estimates of future needs. This budget is reviewed and approved or modified by a Department of Agriculture budget committee and by the Bureau of the Budget before it gets to Congress. Congressional committees hold hearings on the budget requests and modifications of the committee recommendations may be made on the floor. The decision on the appropriation—which ultimately limits the kind and amount of control work that can be done—is thus a result of the joint efforts of many people. And these people are in a position to see many aspects of the decision besides the pest control itself. Earmarked sums are appropriated for white pine blister rust control and for detection and appraisal surveys. The remainder of the appropriation takes the form of a contingent fund. This is the money that is allocated by the Forest Service to specific projects. The Forest Service can

request supplemental funds if it appears by November of any year that pest conditions will be too serious to handle with the available appropriation.

The Forest Service considers it necessary to use pesticides in its pest control programs but it recognizes the dangers involved. To guide the employees engaged in this work the Forest Service Manual contains a clear statement of service policy. Item 5241.21 of the Manual reads in part as follows:

"Prior to application of any pesticide, its toxic effects should be determined and, where required by state and local laws or regulations, necessary legal or other clearance obtained. In addition, suppression measures involving the use of pesticides should be reviewed in advance with federal and state wildlife management agencies and their views obtained on fish and game populations."

"Forest Service policies in the use of pesticides are:

1. When there is a choice between several effective pesticides, to use the one least toxic to wildlife, domestic animals, and humans.
2. To use the minimum amount and concentration of pesticide that is effective for a given insect or disease.
3. To apply pesticides in a careful and safe manner to further minimize harmful effects."

Some important decisions about the use of pesticides have thus been taken out of the hands of the field personnel. The Forest Service has made the basic decisions and has passed these on to its employees as intructions to be followed.

PLANT PEST CONTROL DIVISION

The arrangements within the federal government for dealing with insect and disease pests have been changed a number of times since the establishment of the Federal Horticultural Board in 1912. In the last change, responsibility for forest insects and diseases was transferred to the Forest Service. The organization still responsible for the control of all other plant pests was redesignated as the Plant Pest Control Division of the Agricultural Research Service.

The Agricultural Research Service is a more heterogeneous and apparently less closely integrated agency than is the Forest Service. There is less in the way of written manuals, operating plans, and reports to give a picture of exact policies and procedures. The Plant Pest Control Division appears to be more self-contained and independent than is the Division of Forest Pest Control of the Forest Service. Its activities are, of course, co-ordinated with those of other Agricultural Research Service divisions through the office of the administrator. Programs in which the division participates are fully co-operative with the states concerned. An understanding is reached with each state, outlining areas of responsibility, and policies governing the operation are jointly agreed upon.

The Plant Pest Control Division has two basic responsibilities: administration of the Federal Insecticide, Fungicide, and Rodenticide Act and the detection to prevent spread and control of certain pest organisms. The basic decisions about the marketing and distribution of pesticides were made when the act was written. Plant Pest Control's responsibility is to enforce this act, and the decisions involved are mostly of a factual nature.

The pest control programs are more complex. The division is actually concerned with two different classes of pests: introduced (or invading) pests and native pests which periodically build up to epidemic proportions and spread over several states.

Native insect pests are ordinarily considered to be the responsibility of the individual states. The Plant Pest Control Division co-operates with technical assistance but usually does not engage in control activities itself. Two exceptions are grasshoppers and the Mormon cricket. The programs on these two insects resemble the pattern in the Forest Service. A request for aid originates with the landowner or with the state agency. (Usually it is a group of owners or tenants who desire community-wide action.) This must be approved by the state and then by the division itself. The usual financial arrangement is for the private owner, the state, and the federal government to each pay one-third of the cost. This means that all three take part in the decision to go ahead with a control program.

There is no formal pattern of biological evaluation as in the Forest Service. But through the states and its own local representatives, the division has close working relationships with the state agricultural experiment stations and these help with the biological evaluation and the decision as to control techniques. Plant Pest Control also depends on the Entomology Research Division of the Agricultural Research Service for technical advice and assistance although that division apparently has no veto power over the operating division's decisions. The actual extent of control is difficult to determine because the in-service relationships are so close that the divisions are bound to have considerable influence on each other.

Introduced insect pests pose two problems: preventing the insect from spreading into uninfested areas and controlling the insect in the already infested area or eradicating it from that area. Since invading pests threaten to spread to other states than those first entered, the federal government accepts a primary responsibility for controlling these insects. In every case up to now the states have co-operated in these introduced-insect programs, although the Secretary of Agriculture is empowered by law to act independently, if necessary. The Plant Pest Control division also co-operates with Canada and Mexico in efforts to control insects which cross or might cross the international boundaries.

Invading insects are a different kind of problem from endemic insects. If a foreign pest is introduced accidentally into this country, prompt action is necessary to prevent it from becoming established and spreading. An important part of the division's program is the continuous survey of insect conditions which is carried on in co-operation with the states. One aim of this survey is to discover any introduced pest quickly after it arrives. In order for this program to work, a basic decision must be made on the question: what foreign insects are potential pests and must be watched to prevent their entry into the United States? The responsibility for this decision ultimately rests with the Plant Pest Control Division. But in reality it is a joint decision because information, advice, suggestions, and recommendations come to the division from many entomologists and pest con-

trol agencies both in this country and abroad.

There are three categories of introduced pests to deal with. First is the newly-introduced pest that has not had time to spread very far. Second is the introduced pest which has spread over a considerable area but which might still be eradicated. Third is the introduced pest that is now widely established and apparently beyond hope of eradication. The decision-making process is different for each of these classes.

In the case of a newly introduced pest, prompt action is necessary and the Plant Pest Control Division is empowered to act. The efficiency of the organization itself and of its continuing co-operative arrangements shows up here. State co-operation is needed if quarantine and eradication efforts are to work, but most of the arrangements have been worked out in advance. Through their close contacts and mutual efforts on other programs, the states and the division have integrated their thinking to a considerable extent. A newly introduced pest represents an emergency situation. If there already is agreement that permanent introduction of a particular pest would be disastrous, almost any action to confine and eradicate that pest while it is still in the incipient stage is justified. The power of decision must be delegated to the officials in charge of the control programs. But even in emergencies there should be time to adjust the program if it appears that the officials made decisions which are not factually sound or in line with public desires.

So long as it appears possible to prevent or retard the further spread of an introduced pest, a quarantine is maintained on it. If control of further spread becomes hopeless, the quarantine is abandoned and the insect is then treated like a native. The difference between the second and third classes of introduced pests is that there still is a possibility of eradicating the second kind but all that can be done with the third is to confine it by quarantine. A federal domestic plant quarantine is promulgated only after a public hearing at which all interested parties may present their testimony and opinions. Plant Pest Control Division personnel enforce the federal quarantines regarding interstate movement of regulated articles, and are also authorized to assist in the enforcement of state quarantines.

The lines of distinction between the three classes of introduced insects are blurred and this leads to some conflicts in their control. At some point, an insect may succeed in spreading widely enough that it no longer can be considered an incipient infestation which might easily be eradicated by an intensive program. Eradication of this larger infestation will be more difficult and expensive and is also likely to involve conflicts with many other interests. If the insect continues to spread and become established, it eventually reaches a point where everyone agrees that its eradication is impossible. From then on it is treated like an endemic pest except that quarantine is maintained to slow or prevent further spread and attempts are made to stamp out incipient spot infestations which develop outside the main area. The Japanese beetle is an example of this third class of introduced insect.

The second class of introduced pest is the one that has caused the Plant Pest Control Division the most trouble. This insect is no longer in an incipient stage which might easily be eradicated. It is quite well established and its damage is actual rather than potential. But some people feel that it might be eradicated with recently developed pesticides and techniques. Difficult decisions are called for. When is an infestation large enough that an intensive eradication program can no longer be justified by the chance of saving a large amount of potential damage? And when is an infestation firmly enough established that eradication is impossible?

Eradication itself is a knotty question on which all entomologists and pest control workers do not agree. Some say that no widespread insect can be eradicated by any feasible means. Others point to the Mediterranean fruit fly in Florida as an example that it can be done. The Plant Pest Control Division itself leans toward eradication. With incipient infestations, the division feels that where eradication is feasible it is the proper answer and that the division is justified in promoting the eradication concept in order to get the necessary co-operation for such a program. Some people feel that the division has approached some of the second kind of insects—such as the fire ant and the gypsy moth—with the same philosophy that eradication is the answer and that extra effort is justified to attain this end. The division itself apparently feels that eradication of some of these insects not only is possible but is the rational form of control and that it should encourage an eradication program.

Decisions on the might-be-eradicated insects are not made arbitrarily by the Plant Pest Control Division. Requests for assistance originate with the states and private owners. If they are not willing to bear an equal share of the cost a program cannot be put into effect. (This has been pointed out by the division in its defense of the fire ant program where the farmers themselves are paying one-third of the eradication effort's cost.) Because of the widespread effects of these insects, the decision to undertake a program may be made by a group of states rather than by single states. In the case of the gypsy moth, the Council of State Governments, Regional Plant Boards, and other organizations representing groups of states co-ordinated their opinions and spoke for them. This was necessary because many states that were strongly in favor of a control program did not have the gypsy moth at that time but were in the line of potential spread. In the case of the fire ant, individual farmers, farm groups, and states brought pressure on their representatives in Congress to take joint action for them.

The decision as to whether to undertake an eradication program is made by the division in conference with the states. The state agricultural experiment stations, state colleges, and the Entomology Research Division are drawn on for recommendations and advice, although none of these apparently have any direct veto power over the decision. The state fish and game departments and the Fish and Wildlife Service are

consulted but again these groups apparently cannot block a decision or force it to settlement by a higher departmental official as can be done in the Forest Service. The Plant Pest Control Division appears to be in a stronger position to control the kind of decision that ultimately is made than is the Forest Pest Control Division of the Forest Service.

The immediate and continued opposition to the fire ant eradication program indicates that the provisions made by the Plant Pest Control Division for consultation and co-ordination with other interested agencies and groups were not adequate for a program of this nature. The history of this program and the modifications that have been made in it show that there are means for bringing other interests to bear on the division's actions. However, more formal arrangements than those which now exist for review of decisions might be desirable in an agency engaged in such large-scale application of pesticides.

A superior decision-making power always remains with the Congress in its appropriation function. An annual budget is suggested by the Plant Pest Control Division and reviewed in the department and the Bureau of the Budget before it reaches Congress. The budget estimates include proposed amounts for specific functions and for the control of specific pests. The appropriation which finally is made by Congress does not contain earmarked amounts for individual pests. The division can recommend changes in the amounts originally designated for specific projects based on developments since the budget was approved. Such changes must be approved by higher authority in the department.

STATE INSECT CONTROL

There is no definite pattern among the states as to how insect control is organized. In general, the state agencies are set up to assist farmers and other individuals in their own control efforts. The request for help originates with the individual although the county agent or some other public official may call his attention to the fact that he needs help. Purely state programs may be on a matching basis or the state may pay all of the cost. The state pest control organizations are usually in close contact with the agricultural experiment station and the colleges and are influenced by them in their decisions. They also are influenced by the federal agencies with which they co-operate even on the specific projects which do not involve federal funds. Where federal funds are involved, the federal agency takes an active part in the decision-making. The state legislatures in their studies of budget requests make some critical decisions about pest control. In some states, control programs are almost on an emergency basis and require specific appropriations by the legislature.

INDIVIDUAL INSECT CONTROL

Not much can be said about individual decisions except that they obviously are influenced by the governmental agencies. The farmer is restricted in what chemicals he can use by the registration laws. He is limited in how he uses them by the tolerances enforced by the Food and Drug laws. He is instructed, advised, and encouraged to do various things to control pests. It seems clear that what appear to be free and independent insect control decisions by individuals actually are restricted in a great many ways by the decisions of other people. The latitude in decision-making by the individual is much narrower than one might at first suppose.

JUDGING DECISION MAKING IN PEST CONTROL

The previous sections show that the process of making decisions about pest control and pesticide use in the United States is complex and also highly fragmented. These two characteristics do not necessarily conflict with each other. Indeed, because of the complexity of the problems involved, there may be no other feasible means of dealing with them except through fragmented decisions made by a number of different people. An attempt to centralize decision-making and to make all-inclusive single decisions is likely to founder because of a lack of necessary information or a lack of ability to understand all the factors involved in such an overall decision. With decisions broken up as they now are, the people who must make these partial decisions are better able to understand the facts involved and the probable outcomes of the decisions they make. It is doubtful that any one person could understand the whole problem as completely as these individuals can understand the segments of the problem with which they are concerned.

The present setup would seem to be more likely to lead to rational decisions if it were not for one thing. Somehow all of the individual partial decisions must fit together and be integrated in overall action. If this integration is not accomplished, the overall actions which are taken may not be rational even though each of the individual segments is itself rational. This could result from conflicts between individual decisions in which one nullifies the other or from a bias due to the limited viewpoints of the partial decision makers.

Most of the problems which arise in pest control work probably result from a failure of the fragmented decision-making process to bring into account all of the factors that should be considered. A complete cost-benefit analysis in terms of the real goals was suggested earlier as a means of overcoming this difficulty. But the other material presented in this report and the history of the gypsy moth program indicates that such a complete cost-benefit analysis would be difficult or perhaps even impossible. The way to a solution of

the pest control and pesticide problems does not seem to lie in the establishment of an autocratic organization with power to make complete and final decisions in this field.

Before scrapping the present fragmented decision-making setup we would want proof that an autocratic organization would make better decisions for the public interest. The difficulties in measuring the effect of pest control actions on the basic goals and the uncertainty as to the relative values which people place on these goals make us skeptical that such proof could be forthcoming. This does not prove that the present fragmentary decision-making is more efficient than a more autocratic process would be. But the acceptance of our existing decision-making organization as a starting point does not carry any connotation that it is the best possible of all organizations. The real problem is to evaluate this existing organization and to determine any changes that might lead to more rational decisions in terms of the public interest.

At this point we can return to the cost-benefit concept. It is now evident that the tentative criteria proposed earlier in this report are idealistic. A pest control program ideally should measure up to three standards: The total benefits of the program should exceed its total costs. The benefits obtained should exceed the opportunity costs of the resources used in the program. And the benefits should be obtained at a minimum cost. We have seen the difficulties in trying to apply these criteria to real problems. But the fact that it is difficult—or perhaps even impossible—to measure all costs and benefits does not mean that this criterion is worthless. The cost-benefit approach provides an ideal standard against which to work. The criterion problem in evaluating real pest and pesticide actions is to find ways of measuring as nearly as possible the effects of a proposed action in terms of the ideal standard.

A decision about a proposed action could comply with the ideal criteria only by following certain steps: (1) All costs and benefits that would be involved in the particular action would have to be recognized. (2) Values would have to be placed on these costs and benefits. This would involve recognizing all people with interests that are affected. (3) A determination would have to be made of any differential weights to be given to individual costs and benefits or individual interests. (4) The totals of the costs and benefits with each one given its proper value and weight would have to be determined and compared.

Based on this we can ask four questions which will indicate whether a decision is being made in the way it would have to be made to meet the ideal standards if it were possible to completely meet these standards. These questions are: (1) Are there adequate provisions for determining all the costs and benefits that are involved in the particular decision? (2) Are there adequate provisions for determining the values which people place on the costs and benefits involved in this decision? (3) Are there adequate provisions for applying different weights to various items in order to arrive more nearly at the public interest than would be done by assigning equal weight to everything involved? (4) Are there adequate provisions for bringing together the information from the three preceding questions and combining it in the making of decisions?

These questions as they stand provide a gross test. If the answer to any of them should be "no," there would be serious doubt that the particular action would comply with the cost-benefit criterion of the public interest. The questions might thus be useful in discovering actions that are badly out of line with the criteria. But, even if the answer to all four questions is "yes," there is a great deal of possible latitude in the kind of provisions that might be made. So there could be various degrees of acceptability among actions which passed the gross test provided by these questions.

The problem then is what we mean by "adequate" provisions. At one extreme is no provision, which is unsatisfactory, and at the other extreme is perfect knowledge, which is unattainable. Somewhere between is adequate provision.

We must recognize at this point that obtaining knowledge is an expensive process and that the more adequate provisions are made the more expensive it becomes to improve them. It is conceivable that in some cases the cost of getting the information necessary for making a decision might exceed the total benefits of the action under consideration. The public interest then would be best served by abandoning the attempt to make a decision rather than by expending these costs for information. This places an upper limit to the making of some decisions.

Sometimes, when provision is made for taking the necessary factors into account and collating them, either the costs or the benefits will be obviously larger. Even when the total costs and benefits are uncertain the difference between such totals as can be determined may be so large that one is unquestionably greater than the other. Suppose there was a proposal to spray a residential area to control mosquitoes which were annoying people who wanted to sit outdoors at night. And suppose there was evidence that contact with the pesticide to be used might be fatal to people who were allergic to it. There would be no question about whether this spraying was desirable or not. Even if there was only weak evidence that someone might be killed, the benefits in comfort to the backyard sitters would clearly not outweigh the possible costs. In such an extreme case, very limited provisions for determining costs and benefits would be adequate for decision-making.

But there are bound to be occasions when neither the total costs nor benefits are clearly larger, indicating that the provisions for determining some necessary factors are not adequate. Before a judgment can be made about the proposed action, more information must be obtained about the physical costs and bene-

fits and the values people place on them. Additional information may suffice to show that costs or benefits are clearly predominant. It is not necessary to know everything about costs and benefits and values before a rational decision can be made. Provisions may be considered adequate when they produce enough information to permit a definite determination. When, in reviewing a situation, a point is reached where the cost of obtaining more information would be very high it may be best to abandon consideration of that action rather than to incur greater costs which still may not provide an answer.

PROBLEM SITUATIONS IN PEST CONTROL

Let us now look at the kinds of situations that exist in pest control and the ways in which the tests proposed in the previous section might be used. For purposes of analysis we can recognize three levels of problem situations.

The first is a single problem situation. This is fairly simple, and a single definite decision can be made. An example is a decision by a farmer to spray his crop field or by a local governmental unit to spray its own area for mosquito or gypsy moth control. These decisions ordinarily are made by single individuals or small organizations.

Because of the specific and simple nature of these single problem situations it is possible to determine definitely the provisions that are made to collect and assemble information on costs and benefits. In general, these single action situations appear susceptible to test with the cost-benefit criteria.

The second kind of situation is what we will call a program: A program consists of a series of single decisions and actions regarding a specific pest and a definite attempt to do something about it. Decision-making is ordinarily fragmented, i.e., a number of different individuals or organizations make partial decisions. However, in a program there is always some form of central control. This permits the co-ordination of the fragmented decisions and their combination in a continuing program. The gypsy moth control program is an example.

A program consists of a more-or-less continuous decision-making process, either a series of simple decisions about single actions or a set of co-ordinated decisions about a number of single actions carried on simultaneously. In either event, action in a program results from successive decisions and is therefore susceptible to change and adjustment. A program is characterized by some organized pattern of control which permits centralized decision-making.

The complex nature of a program makes it difficult to test with the cost-benefit criteria. However, it should be possible to determine what provisions there are for taking the steps that would be necessary to apply such criteria. The question in a program situation is: Are there adequate provisions for determining the facts needed for the process of making a succession of single decisions? Because of their organized control pattern, it should be possible to test whether programs make the necessary provisions and whether they are adequate.

By their nature programs involve larger areas, more basic goals, and more individual people than do single-problem situations. When a number of single problems comprise a program, the whole program involves different costs and benefits than any one of the single problems. Since these are dealt with simultaneously or in a series of decisions, it is necessary to recognize that they are not independent of each other. Programs must take into account the fact that individual problems may have cumulative effects or may in some way interact with each other. An isolated analysis of one of the single problems in a program might not include all the real costs and benefits which action on that problem would involve as a part of the total program. Cost-benefit analysis in a program situation must allow for all the costs and benefits in the whole program when considering an individual single problem situation on which a decision must be made.

The third type is what may be called a composite problem situation, involving many single decisions and programs. These single actions and programs may occur in series or simultaneously. All of them together make up the composite problem situation, which, for example, might consist of all the actions taken to control pests with chemicals in some geographical area, such as a state. Within this state there will be many individual applications of pesticides and probably a number of programs using pesticides. These single actions and programs may be independent to the extent that they are conducted by different people or organizations. They are likely to be aimed at different pests and may have different objectives. Yet all together they have a combined effect on the pest situation in the area which can be measured in terms of total costs and benefits.

There is no organized pattern of control in these composite situations. Whereas in programs the individual decisions and actions on single problems are co-ordinated by some kind of central control mechanism, in a composite situation the individual decisions are not brought together in any organized way. This is unfortunate, because these separate actions are not independent of each other in their effects. When considered separately they may appear to involve certain benefits and costs. But when carried on simultaneously they may interact in such a way as to produce different benefits and costs. For example, a farmer spraying a single crop field for insect control may not kill enough birds to affect the total bird population. But if every farmer in the county sprays his fields with the same insecticide and in the same manner, the total number of birds killed may be sufficient to wipe out the population in the county. The serious problem is that individual single actions and programs may appear to be rational and justified in the public interest when tested only in terms of their own separate costs and benefits.

It is these composite situations that are of most concern to those assessing the present status of pest control and the use of chemical pesticides. But it is also at this level that there appears to be no possibility of making a total analysis of costs and benefits and definitely determining whether the situation is desirable or not. Nevertheless, composite situations may be tested by asking what provisions there are for taking the steps that would be necessary to make an overall cost-benefit determination were such an analysis feasible. For example, what provisions are there for determining the composite effects of all the actions in the particular geographical area on all the basic goals involved? Unless there are provisions for determining the composite costs and benefits in this area and the values which people place on them, there is no possibility of evaluating the composite situation.

The most difficult question concerns the provisions for bringing together information on costs and benefits, values and weights, and combining this in making decisions. The decisions actually are made in the single problem and program situations which make up the composite. A change in the composite situation can only result from changes in these single actions and programs. The decisions to be influenced by a comparison of the composite total benefits and costs are the decisions made at the single and program situation levels.

We need provision at the composite level for bringing together total information on the costs and benefits of composite actions. And there must be some means by which this information can serve to guide decisions at the single and program levels. This does not necessarily mean a centralized decision-making organization for the composite situation. It does mean that there must be some mechanism for passing this information on to those who make single and program decisions so that their decisions will be influenced by the effect of their actions on the composite situation. There also must be some means of controlling certain decisions at these levels which clearly would be undesirable in terms of the composite situation.

These three classes are only an artificial subdivision. There are all kinds of situations, and in many cases they overlap each other. In the nature of a program type of situation there could be a state pest-control program which dealt with all pests in that state. This would cross boundary lines as far as separate pests are concerned but would be a unified program dealing with a particular problem area. The Forest Service pest control program on the national forests could also be considered as a program situation, although it deals with different pests on widely scattered areas. The composite type of situation can occur at many levels. It exists where ever many individuals are using pesticides in different ways to control insects within one area. A much more complicated situation exists when all of the pest control actions taken in the United States are considered as the composite. The important thing is to recognize that at one extreme there are simple single problem situations where decisions are made by individual decision makers. At the other extreme are very complex composite situations made up of large numbers of individual decision-making situations where there is no centralized control over the whole complex situation.

The single simple situations appear to be definite and susceptible to determinate analysis as to their desirability in terms of costs and benefits. However, since these situations are the building blocks which make up the program and composite situations, they are not quite as simple as they appear. Unless their contribution to the composite effect is taken into account, all that a cost-benefit analysis of the single situations in isolation may do is to give a misleading impression of their desirability. The situation that we are really interested in is the overall composite one. Unfortunately, this is the kind in which it appears to be virtually impossible to make determinate analyses.

CONCLUSIONS ABOUT CRITERIA

Our attempt to develop criteria for judging pest control and pesticide use has clearly met only limited success. But however inadequate these criteria may be for the purpose for which we would like to use them, they are better than no standards at all. Without some criteria there is no possibility of resolving the many conflicts of personal interests involved in an activity like pest control. The criteria proposed here may permit sufficient agreement that action can proceed without continuous conflict.

The cost-benefit analysis in its simplest form seems applicable to single simple project situations. There will still be questions about the values to be applied to certain costs and benefits, the weights to be given to certain values, and the composite effects which do not show up directly in individual cases. But allowing for these things, it should be possible to determine with reasonable accuracy whether a single small action is in the public interest or not. If nothing more, such an analysis will reveal any glaring lack of information on costs and benefits or values.

If each of the small single decisions going into the makeup of a program is based on a cost-benefit type of analysis, the program as a whole should have a reasonable likelihood of being desirable. A program is more than just a mass of individual decisions. In

order to be a program it requires some kind of coordination and organized effort at central control of the single small decisions that are made. The process set up for this centralized control of the individual decisions can also be tested with our criteria. This process must demonstrate that adequate provisions are made for obtaining the necessary information and comparing it in deciding whether to proceed with certain actions or not.

At the program level the information needed is more complex and difficult to obtain. And it is necessary to recognize the composite effects of all the individual actions involved. However, it appears that programs can still be tested with reasonable accuracy by using the criteria suggested here. Assessment difficulty indicates that the program is inadequately prepared.

The suggested criteria would appear to have utility for testing and guiding single actions and programs. It is in the composite situation, where we must try to judge the overall effect of a number of single actions and programs, that the criteria seem to lose their usefulness. But these situations differ only in their greater complexity and in the lack of any centralized decision-making arrangement. It should be possible to apply the criteria to these composite situations and to ask whether there is adequate provision for determining the information needed to make a cost-benefit analysis.

Provision must be made for bringing information on the composite effects of individual actions together and presenting it to the people who make the individual decisions. If this is not adequate, the individual decision makers cannot know what the composite effects of their actions will be nor take it into account in making their decisions.

The suggested criteria may be useful in discovering whether there are ways in which composite situations might be improved. The criteria can hardly be used to judge composite situations and to say whether they are good or bad. But they can be used to determine whether there is a satisfactory decision-making process at this composite level, and whether there is a need for additional effort or for additional provisions at this level if the whole composite pest control situation is to operate in the public interest.

HOW DOES THE PRESENT SITUATION MEASURE UP?

Suppose we now try to apply these criteria in a general way to the existing situation. We have seen that the Forest Service, the Plant Pest Control Division, and the various state agencies make a kind of cost-benefit analysis of single actions as they come up for decision. We may question whether they always take all of the costs and benefits into consideration and whether the values they use for these costs and benefits really represent the judgments of the people concerned. However, a sort of machinery does exist for comparing the costs and benefits of single actions and for trying to limit actions to those whose benefits will exceed their costs. The information used seems to be weak in many cases. So there still appears to be room for more complete and accurate determinations in making decisions on single specific actions.

Many existing programs also seem to conform reasonably well with the criteria. The rather elaborate pattern of review and approval in the Forest Service appears to make provision for gathering information on costs and benefits, determining their values, applying differential weights to different items, and bringing this information together for comparison and final decision. The less clearly defined arrangements of the Plant Pest Control Division and of various state agencies also seem designed to meet these criteria requirements. The question probably is not whether such provisions are made for most programs but rather how adequate provisions are.

Many programs try to achieve adequate provision by dividing responsibility among various organizations or individuals. One example of this is review by a research organization and another is liaison between the control agencies and the Fish and Wildlife Service and state game departments. The provisions for obtaining information for decisions in these programs have improved materially in recent years. (Undoubtedly this has been stimulated to some extent by the controversy over pesticides.) But the fact that well-informed people still disagree as to whether certain actions would be desirable in some programs indicates that provisions for obtaining information are inadequate.

The most serious weakness seems to lie in the provisions for bringing information together and comparing costs and benefits. Even if better information is obtained there still remains the problem of using it in making decisions. The gypsy moth program, for example, is a co-operative undertaking between federal and state agencies. Decisions about individual actions have to be made on a co-operative basis by the agencies involved. And yet decisions made in one state affect those which can be made in another state. If some states are unwilling to co-operate in an eradication undertaking, other states cannot hope to eradicate the insect. There obviously are many difficulties in bringing together information on a program as diversified as gypsy moth control and in making decisions about specific actions. Better information on the costs and benefits of an extermination program would simplify this. But the present difficulties in bringing value judgments to play on the decision through co-operative decision-making would still remain.

Inadequate provisions for taking costs and benefits into account in decision-making may actually prevent actions that would be desirable. In the gypsy moth case, for example, it is possible that an eradication campaign would be in the public interest. However, at present the lack of information on the costs and benefits of such a campaign and the provisions for bringing value judgments to bear through the required co-operation between agencies, prevent such a campaign from getting under way. The present sparring over this campaign may prove to be desirable if

it turns out that eradication is not feasible. But if eradication should be feasible and in the public interest, the present inadequate provisions for decision-making are blocking a program which would be desirable now.

The composite situations are the most difficult to assess. Because of the lack of centralized control, there is no one place to start in trying to apply the criteria. At the same time it is plain that there are some provisions for assembling necessary information and comparing it in these composite situations.

Various interested groups and organizations have tried—and continue to try—to assemble information on the costs and benefits of composite situations. In many cases their motivation has been the hope of justifying or discrediting a particular program. Usually these have not been complete efforts to gather total information on the whole picture but rather have been fragmentary in nature. However, the information assembled by all these separate efforts represents a considerable amount of data on the composite costs and benefits of the use of pesticides and pest control.

There are not many instances of a specific assignment of responsibility in this area. The Public Health Service is responsible for determining the effects of pesticides on human health. And the Fish and Wildlife Service has been given the job of determining the effects of pesticides on wildlife. Both organizations are in a position to consider composite effects, as the Public Health Service is doing in its study of stream contamination resulting from pesticide use in watersheds. There is a need for more investigation of this kind to develop reliable data on the composite costs and benefits of pest control.

A few studies—like one made by Dr. John George for the Conservation Foundation—have tried to bring together information on the composite effects of pesticide use. Numerous conferences and meetings have tried to consolidate the views of different specialists on the composite effects of pest control. These have contributed to our knowledge. But present provisions for determining the composite costs and benefits of pest control actions are still inadequate to say whether these actions are desirable or not.

Information is even more sketchy on the values people place on the costs and benefits involved in the composite situation. Some people's values are expressed through the actions of interest groups in opposing or favoring certain pest control programs. But provisions are not very good for determining the value judgments of everyone involved in these composite situations. This is handled to some extent through the political process in the actions of legislatures on appropriations and laws regarding pest control. All in all, however, the provisions for determining the values involved in pest control appear to be inadequate.

Some provision exists for giving different weights to different individuals and costs and benefits in the composite situation. The tolerance requirements of the Food and Drug laws give a heavy weight to health as a factor in pest control. This weighting takes the form of restrictions on the decisions that can be made about the use of certain pesticides. There has been a tendency in the past to give more weight to the production of material goods than to such things as recreational opportunities and aesthetic satisfaction. The present trend seems to be in the opposite direction with more emphasis on these other values. Some people question whether environmental stability receives enough weight even today in the consideration of composite pest control situations. Although there are some provisions for giving weights to various factors in the composite situation, the existing ones seem hardly adequate to deal with a problem of this complexity.

Finally we come to the provisions for assembling information on the composite costs and benefits and values of pest control and for balancing costs against benefits in such situations. Some interest groups try to assemble this kind of information but usually what they bring together is not complete and sometimes it is badly biased. No public agency or private organization has been assigned the responsibility for assembling information on these composite situations. This might be done best by a number of separate organizations, each making its own attempt to bring information together and to make it available to decision makers. Such separate efforts deal with separate composite situations. Or they might analyze the same situation in different and independent ways. Perhaps an attempt to develop a single co-operative effort in this direction would be more effective. In any event, it appears that present provisions for assembling this information and for making it available to decision makers are inadequate.

This seems to indicate that although there are gaps and weaknesses in the existing arrangements for pest control decision-making at all levels, the most serious weaknesses are at the composite level. There appear to be reasonable provisions for determining costs and benefits at the single problem level and at the program level. The provisions for determining costs and benefits in the composite situations, however, are quite inadequate. Since these composite costs and benefits form a part of the total costs and benefits of the single and program situations, the provisions at those levels may be worse than they appear. The greatest need for effort seems to lie in providing means of analyzing the composite situations and determining the costs, benefits, and values involved in them.

CONCLUSIONS

Pest control is an exceedingly complicated field of human activity. It deals not only with complex biological relationships between pests and their environment but also with equally complex human relationships. The basic objective—to control pest organisms in the interest of the welfare of mankind—is easy to state. But it is not so easy to determine what actions will accomplish that objective. This study shows that it is hard indeed to set up specific criteria which can be used to test pest control actions in the light of the basic objective.

Cost-benefit analysis appears to be one feasible means of establishing usable criteria for testing pest control actions. For this purpose, costs and benefits must be expressed in terms of basic human goals such as material goods and services, health, comfort, leisure, aesthetic satisfaction, opportunity for recreation, and stability of existence. These benefits and costs must also be valued in terms of the public interest rather than any individual interests. With these prerequisites, three requirements may be established as criteria for judging pest control actions. These are that the total benefits from the action must exceed its total costs, these benefits must be obtained at the least possible cost, and the benefits from this action must exceed those that could be obtained from using the same resources in the best alternative opportunity.

These cost-benefit criteria set an ideal standard that is difficult to use in practice. The best that usually can be done is to test the process through which decisions are made in terms of the adequacy of its provisions for obtaining the information that would be needed to make a cost-benefit analysis. A usable standard for testing pest control decisions consists of: adequate provisions for determining the costs and benefits of the action in physical terms, for determining the values to be applied to those costs and benefits, for determining any differential weights to be given to different values or individuals, and for assembling the information thus obtained and comparing the total benefits and costs. Provisions may be considered adequate when they produce enough information to determine definitely whether benefits exceed costs.

These standard provisions appear to be a feasible means of evaluating single action situations and program situations in pest control. Many single action situations may be evaluated by the cost-benefit criteria directly rather than through testing the adequacy of provisions for necessary information.

The composite situations, which are made up of many separate pest control actions and in which there is no organized central control, are more difficult to evaluate with these criteria. The composite situation results from many decisions made by various organizations and people. It can only be changed by changing the single and program decisions which make up the composite. The provisions for obtaining the necessary cost-benefit information and for bringing it to bear on the decisions which make up the composite are highly fragmented and difficult to determine. This fragmentation seems to be desirable, but its efficiency depends on the completeness of its coverage and on the way the information is brought to bear on the actual decision-making. These composite situations appear susceptible to evaluation in terms of the adequacy of their provisions for obtaining the information necessary for a cost-benefit comparison. But the provisions are so complex that it is not easy to apply the criteria to these composite situations.

The existing pattern of pest-control decision-making in the United States is more comprehensive and complete than most people realize. Many different individuals, groups, and organizations take part in making any major decision. These represent the different interests involved in pest control. Some of these interests are represented by specific assignment of responsibility from the legislatures. Other interests are represented through their ability to influence the people actively carrying on pest control work. A complex pattern of co-operative arrangements, checking, review, and successive approval exists for practically all pest control work. This does not necessarily ensure adequate provisions for determining everything that should be known, but the existing provisions are certainly more adequate than they might at first appear.

The greatest weakness at present is at the composite situation level. The individuals and organizations who carry on single actions and programs appear to be making definite efforts to do the things that would be required by the cost-benefit criteria. There is still room for improvement at these levels, but the necessary action seems to be reasonably straightforward. It is at the composite level that it is difficult to suggest how the present situation might be changed to comply more fully with the requirement of adequate provisions for obtaining the information necessary to compare benefits and costs.

Many of the people active in pest control work appear to be aware of these weaknesses and anxious to overcome them. This is particularly true of individuals at the policy-making level in pest-control organizations. Progress is being made, and the provisions become more adequate each year.

Two general recommendations seem indicated by this study. The first is that greater efforts should be made to evaluate pest control decisions on a continuing basis. These should range from specific attempts to determine the costs and benefits of single decisions to broad efforts to evaluate the composite situations. Further study may well develop better means for evaluating composite situations. Some large-scale attempts at complete analyses of these composite situations must be made before we will know how serious these situations are and what can be done about them.

The second recommendation is that efforts be made to increase the provisions for obtaining information on pest control and pesticides at all levels. Even where it appears possible at the present time to make comparisons of costs and benefits, these analyses are seriously handicapped by the lack of reliable information. Better information is especially needed on the possibilities of obtaining the desired benefits at lower costs through the development of new means of pest control.

Edgewater Gulf Hotel to Host AFA 1960 Meeting

Edgewater Gulf Hotel, Edgewater Park, Mississippi, is located on Gulf of Mexico

THE American Forestry Association will hold its 85th Annual Meeting, October 16, 17, 18, and 19, at the Edgewater Gulf Hotel, Edgewater Park, Mississippi. Located on the Gulf of Mexico, the Edgewater Gulf Hotel is situated midway between Gulfport and Biloxi. The hotel has a maximum capacity of 750. It also has 700 acres of landscaped grounds providing a wide array of recreational opportunities.

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MAKE YOUR RESERVATION TODAY

Hoosier National Forest

(*From page* 13)

incredible size. The process still goes on today. Mining companies do their best to treat the land kindly, but scars are inevitable.

In 1935 hopes were high that 500,000 acres would be nursed back into healthy productivity through the medium of the Hoosier National Forest. That first year some 35,000 acres were optioned and approved for purchase. Had that pace been maintained, the entire program would be well on its way to completion in this year of our Lord, 1960. But the war years stopped all land acquisition. Since the war Congress had budgeted only nominal sums for land purchases (something like $100,000 per year for the entire nation). Although the Hoosier Forest has received proportionately large chunks of that money, not more than 40,000 acres have been added to the forest since the war.

The Hoosier National Forest is not a contiguous area. Rather it is divided into two sections – 534,000 acres in the southern portion, and 188,000 acres in the Monroe and Brown Counties section. About one-third of the area is land suitable for farming—particularly if the hills are given some cover to stop erosion and silting. This land no one has any intention of including in the national forest. But the other two-thirds, scarred, gullied and neglected, needs attention desperately. The aim of the Hoosier National Forest is to rehabilitate this land both for timber production and watershed protection. The arable land thereby will be fully restored to full fertility, too.

All purchases of land for the Hoosier National Forest are made on the open market. Land suitable for inclusion in the forest is purchased as funds are available and owners are willing to sell at the market price. No lands are condemned or acquired by forced sale.

The struggles of Congress and the administration to maintain a balanced budget can evoke nothing but admiration and sympathy from a thinking citizen. The dangers of runaway inflation are too great to entertain any other reaction. But a wise old saw maintains that "a stitch in time saves nine." In the case of the Hoosier National Forest, I believe the saw is particularly meaningful.

Land in the area is growing more expensive year by year. With population pressures increasing, this trend is not likely to reverse itself soon. Meanwhile, the land deteriorates still further with each winter storm and spring runoff, so the cost of rehabilitation becomes greater with each passing year.

This may not appear to be a propitious time to buy land, but it is the best that will exist for a long, long time to come. Land prices and rehabilitation costs have no way to go but up.

If the current rate of land acquisition is not accelerated, it will take a full century to complete the land acquisition program. By then, some of the land may be ruined beyond repair.

Taxwise, the industrial areas and the fertile farm belt of Indiana are required to carry the southern rural counties simply because the tax base is not there. More than one of these counties is on the ragged edge of bankruptcy. The one great hope they have of achieving financial stability lies in their forest lands.

A sizable woodworking industry already exists in this section. But the plants that operate there are finding the competition increasingly difficult as necessity compels them to reach farther afield for their log supplies.

Yet they are located in the heart of one of the best timber-growing areas in the whole middle west. The rainfall is higher and the growing season is longer than Wisconsin's or Minnesota's. Consequently, timber grows faster. Producing at full potential, the forest lands of southern Indiana could support several times as many woodworking plants as are operating there currently. One or two pulp mills could find plenty of raw materials there, too.

But none of these things will develop until Hoosier National Forest is made a going concern. The importance of the forest lies not only in the fact that it will rehabilitate hundreds of thousands of run-down acres, but also in the fact it will give woodlot owners an example of what good forestry practice can accomplish.

There are millions of acres of forest lands tied up in small, privately-owned woodlots in Indiana. Many of these are neglected and unimproved. Cattle and pigs have been allowed to graze at will. The result is that woodlots produce only a fraction of their potential yield, either in quantity or quality. Properly managed, they could yield a tremendous amount of sawtimber and raw material for pulp, while increasing the cash income of the farmers. The key is and will remain completion of Hoosier National Forest.

Aside from its timber-growing potential, the area holds another great promise—a recreational area of unlimited possibilities. Only two areas are adequately developed at the present time: the German Ridge area and the Pioneer Mothers' Memorial Forest near Paoli. The German Ridge area, near Tell City, includes a three-acre lake that offers good fishing, improved camping spots, and adequate picnic grounds. Both of these areas are used extensively but, properly developed, they could accommodate many times their present clientele.

In a real sense, southern Indiana is a testing ground for the nation. Within its confines are hundreds of thousands of acres that could, if properly managed, provide vast amounts of timber resources and wonderful recreation facilities, while at the same time restoring watersheds and rehabilitating farmland to optimum productivity.

The aim of Hoosier National Forest is multiple use of the land: farm

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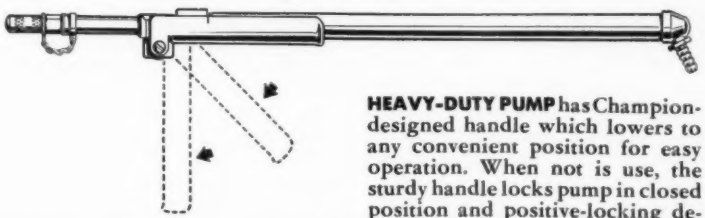

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District Attorney Boyce Holleman, Wiggins, Miss., will address group

AFA Annual Meeting Highlights

"Products of the Forests" has been selected as the theme for AFA's annual meeting to be held at the Edgewater Gulf Hotel, Mississippi, on October 16-19. This theme was chosen in honor of National Forests Products Week, which will receive a special salute in the form of a pageant, produced and directed by William Bergoffen of the Forest Service.

Senator John C. Stennis of Mississippi will keynote the meeting as well as participate in the dedication ceremony of the Research Laboratory, Southern Forest Experiment Station, an event which AFA members are invited to attend. The dedication will take place in Gulfport at 3 P.M. on October 16.

Other distinguished annual meeting speakers include Richard E. McArdle, chief of the Forest Service; Frank Heyward, Crown-Zellerbach Corporation; Boyce Holleman, district attorney, Wiggins, Mississippi; Voit Gilmore, vice chairman, Forestry Committee, North Carolina Conservation Board of Development and Forestry, and Philip E. Frankfort, president of the Southern Pine Association.

On Monday evening, October 17, there will be a dinner in honor of the southern forestry associations which include Alabama Forest Products Association, Florida Forestry Association, Georgia Forestry Association, Louisiana Forestry Association, Mississippi Forestry Association, North Carolina Forestry Association, Texas Forestry Association, Virginia Forests, Inc., Southern Pulpwood Conservation Association, Forest Farmers Association, and Southern Pine Association. David James of Simpson Timber Company will be toastmaster for this event.

On October 18 AFA members will be treated to an all-day tour of the Bogalusa Plantations of the Crown-Zellerbach Corporation. There will be interesting field demonstrations and a barbecue luncheon. Member will travel via chartered buses.

The sessions on October 19 will be devoted to panel discussions. Moderators will be X. L. Pellicer, vice president, St. Augustine National Bank, and Mrs. Katherine Jackson Lee, an AFA director and member of the Outdoor Recreation Resources Review Commission. Topics will be "Round Up of Southern Fire Prevention Progress Since 1956," "Recreation and Wildlife in Southern Forests," "The Challenge to Lumber," "The Feminine Point of View," "Youth Examines Its Heritage," and "Christmas Trees for Fun and Profit."

The annual banquet on Wednesday, October 19, will be the final event of the AFA meeting at Edgewater Gulf Hotel.

lands dedicated to farming, wilderness areas providing timber, recreation, and water conservation. The potential is there, the will is there; all that is lacking is completion of Hoosier National Forest as originally contemplated.

Admittedly this will require some additional money in an era when economy looms large in the thinking of the government. But conservation seldom comes free. It usually involves investment of both time and money, but nothing pays larger or surer dividends over the long haul.

Completion of Hoosier National Forest is an investment Uncle Sam can scarcely overlook much longer.

Blights on the Nation's Landscape

(*From page* 20)

These are *not* true indications of the travel taste of the American public. The great surge to the national parks and forests demonstrates that people appreciate a clean, growing America and are willing to travel great distances to find it. Worthwhile private tourist attractions fill an important role, too. Colonial Williamsburg, Virginia, its attendance rising year after year, has proven that it is possible to combine enjoyment with education. Best of all, Williamsburg has treated its visitors like twentieth-century grownups, and they have responded in kind by absorbing the lessons of early-day Virginia. At Tucson, the Arizona-Sonora Desert Museum is the model new attraction in America—educational, entertaining, complete with aquariums, botanical gardens, animals, and bird life. Even the souvenirs have quality, although they are not necessarily expensive.

As for resort communities, La Jolla and Santa Barbara, on the Pacific shore in California, have shown over the years that zoning for beauty pays business dividends, a lesson many other areas which have deteriorated into resort slums did not learn. Even in their current expansion and growth, La Jolla and Santa Barbara manage to maintain their standards and to benefit commercially in the long run. These older, sophisticated communities are not the only ones where planning has paid off. Gatlinburg, Tennessee, has boomed since the establishment of the Great Smoky Mountains National Park next door, but as a worthy gateway to the park, even preserving something of its old mountaineer flavor in the process.

In the changing shape of America, cities are making dramatic progress, largely as a result of urban renewal developments. Curiously, while the open spaces are being swallowed up and spoliated, the old city slums are being reclaimed both for city dwellers and tourists. Philadelphia, one of the nation's oldest, most worn-out cities, is undergoing a face-lifting on a grand scale. Within Penn City, covering fifteen downtown blocks, skyscrapers tower over spacious esplanades, while underground, modern air-conditioned stores line street-wide passageways. Nearby, the national shrines clustered around venerable Independence Hall have greater visibility and prominence than ever before.

Pittsburgh is even more spectacular. The nation's great steel-producing center and erstwhile grimy Smoky City has replaced downtown blight with parkland and uncongested towering aluminum and stainless steel office buildings. Now you can see and appreciate the fine points of an historic river city, including the tiny brick blockhouse, the last vestige of Old Fort Pitt, the cliffside incline railway which rises to a summit high above the confluence of the Allegheny and Monongahela Rivers to form the Ohio, and the Carnegie Institute, a leading fine arts gallery and natural history museum. The Pittsburgh renaissance has spread outward, giving uplift to all Western Pennsylvania, bringing attention to the ten state parks and other points of interest within 100 miles of the city.

Many other towns and cities are taking a new look at their antiquated corners. However, instead of demolishing all their old buildings, they are restoring them to original appearance. By so doing, they not only preserve historic elements, but benefit commercially. Real estate values rise, tourists are attracted, the community assumes a new lease on life. The Georgetown section of Washington, D. C., is probably the prime example, retaining an insular aura of antiquity while surrounded by newness; in recent years old homes, almost lost in misuse, have been restored to their earlier appearance. Guided and spurred on by the National Trust for Historic Preservation, other cities, or sections of them, have been following the same general pattern. These include Annapolis, Maryland; Savannah, Georgia; New Orleans, Louisiana, with its famous Vieux Carre protected by diligent zoning, and most recently, historic Richmond, Virginia.

There is something to be said for the beauty of the synthetic in the tourist scene, too. Disneyland may not be exactly real, but there is sheer wonder in its magic, and it is just as much an expression of the American spirit as the components it synthesizes: the frontier West, old fashioned Main Street, the Grand Canyon, the monorail and moon rockets of tomorrow. Disneyland represents imagination and creativeness, the kind of mirror of America we should want Khrushchev (who was thwarted from making the visit when he was in California) and all other foreign tourists to see.

But what kind of America do home-grown vacationers really want to enjoy? Perhaps we can escape the blight in national parks, forests, state parks, and highly-endowed attractions like Colonial Williamsburg. But with the rising tide of travel and leisure time pursuits, these will never be adequate again. There is a challenge here to private enterprise to exercise mature taste and judgment in the facilities it provides the traveling public. A challenge to the states and local communities to safeguard their roadsides and landscape generally. Above all, perhaps, there

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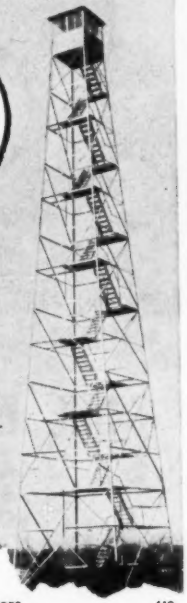

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is a question of pride involved. Why should the average European feel more pride in his national landscape than we do in ours? Along with travel enjoyment, now is the time for proud Americans to take a hard, critical look at their countryside and help decide its future.

The Hemlocks of Mianus Gorge

(*From page* 17)

the remaining payments could be raised, although they were not certain where or how. Anyway, there was no time to quibble or be cautious. Let's go ahead, they said. And they did.

Now $3,000 in debt and with another payment due only a short time off, the effort to save the trees at Mianus Gorge seemed doomed. However, Richard H. Pough, one of the scientists who had visited the gorge with Mrs. Anable, came to the rescue. As president of the Nature Conservancy, he interested that organization in advancing $7,500 from its loan fund. In addition, by becoming an official undertaking of the conservancy, Mrs. Anable's group was able to obtain tax exemption.

This assistance provided the effort to save the trees at Mianus with a new lease on life. There was now time to conduct a fund-raising drive. Meanwhile, several newspapers had printed stories about the gorge, and a brochure had been prepared and distributed to members of Audubon and garden clubs within the area. As a result, money gradually began to come in.

In Greenwich, Connecticut, the Garden Club offered to make the gorge the subject of its annual fund-raising exhibit. Although the money was not actually raised until several months later, it amounted to a total of $12,000. This and other contributions made it possible not only to buy the first land, but also to repay the Nature Conservancy's loan within a year. Becoming enthusiastic over the project, some of the people who owned land near the gorge gave additional acreage. (The owner of the original 60 acres contributed another ten and has been a helpful supporter of the group's work ever since.) Altogether, the gifts received have made possible the acquisition of another 98 acres and the beginnings of an endowment fund.

Much work remains to be done before the hemlocks are fully protected. At least 25 to 30 additional acres

are needed, and more donations are required to complete the endowment fund. Nevertheless, the originators of the efforts to save the trees can look back on their accomplishments with satisfaction. Trails have been built through the area, a warden-naturalist is on duty weekends (because of the gorge's proximity to the city, one is needed all year round), a natural history exhibit has been constructed at the parking lot and—most important of all—the giant hemlocks have been saved.

But perhaps the real accomplishment lies in the reactions of the thousands of visitors who walk the forest floor every day. The boy from the Bronx is noisy walking into the woods; on the return trail, he is silent. The biology class from a neighboring high school sees that the wilderness is more than an illustration in a textbook. The bird-watcher, swinging his glasses upward as he catches the sound of an unrecognized song, feels free of the pressures that have haunted him all week.

The preservation of the hemlocks at Mianus Gorge is not only a triumph of aesthetics over practicality, of scientific needs over the physical requirements of our civilization; it is also an adventure in human values, in giving people an insight into the world from which they came and the peace that can be found in rediscovering it.

Today, the centuries-old trees stand as a tribute to a woman—Mrs. Anthony Anable—and the many people who supported her in her determination to save a piece of wild America for future generations. And they also show what other communities can do with wise and courageous leadership.

Reading About Resources

(*From page 4*)

scheme for re-landscaping what has grown passé. The second volume is aimed strictly at the student and the serious gardener. Its technical-reference character would repel most suburbanites. The first is tailored as neatly to suburbanites as a station wagon. Both do their intended jobs with unusual competence.

Biology and Control of the Western Pine Beetle, A Summary of the First Fifty Years of Research, by J. M. Miller and F. P. Keen (U. S. Dept. of Ag., 1960. 381 pp. $2.25). A man-sized job of recounting the history of some of the most important research ever undertaken in U. S. forestry. The book gives perspective, which is another word for wisdom.

Meet the Southwest Deserts, by Philip Welles, photography by Marvin H. Frost, Sr. (Dale Stuart King, Globe, Arizona, 1960. 82 pp. $1.00). An inexpensive, paper-bound tourist's handbook to the astonishing natural wonders of desert life. Well worth packing in the vacation duffle.

Shooting, Hunting, Instructor's Guide, prepared by American Association for Health, Physical Education, and Recreation Committee under supervision of Julia W. Smith (National Education Association, Wash., D. C., 1960. 94 pp. $2.00). A handsome booklet that will be useful to learners as well as instructors, I would recommend this as a gift for any teen-aged boy. It's full of obvious good sense that is too easily overlooked in enthusiasm to buy a gun and pull the trigger.

Yearbook of Forest Products Statistics, 1959, prepared by the Food and Agriculture Organization of the United Nations (Columbia University Press. 157 pp. $2.50). Perhaps the one indispensable reference work for last-minute statistical data concerning the world forestry situation, this annual is familiar and essential to thousands of people.

Notes on Western Range Forbs: Equisetaceae through Fumariaceae, by William A. Dayton (Forest Service, U. S. Dept. of Ag., 1960. 254 pp. $1.75). This carefully-done little volume is as technical as its title suggests, and obviously useful only to those who are wrapped up, so to speak, in everything from Equisetaceae to Fumariaceae. It represents the hard spade-work that lies behind all good resource management.

Dictionary of the American Indian, by John Stoutenburgh, Jr. (Philosophical Library, N. Y., 1960. 462 pp. $10.00). A scholarly, offbeat work that will enable anyone to speak Indian (American) in monosyllables ranging from *Aatsosni* to *Zuni Pueblo.* For word-dropping that is sure to stop friends dead in their tracks, you could learn from this book to exclaim, upon awakening on a cold winter's morning, "My, my, the *tacquacat* is on the pumpkin"—and that's something no man could ever do without this book!

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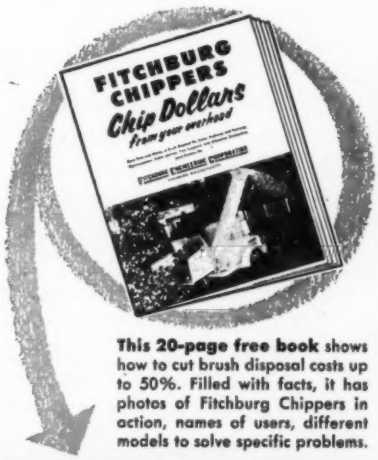

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TREES AS GOOD CITIZENS

By CHARLES LATHROP PACK

The American Forestry Association has just obtained a limited number of copies of this valuable book, first published by The American Tree Association in 1922. It was so popular, it enjoyed four printings. Our copies are in perfect condition and most of the basic information is as valuable today as in 1922. Today this book would cost at least $5.00 to reproduce, but we will make copies available as long as they last for $2.00 each, postpaid. Original price, $4.00

In simple, intensely interesting words, with many clear pictures this book tells the whole story of the shade tree. How to identify varieties; which to plant in different localities to meet conditions of soil, climate and situation; how to keep trees healthy and free from injurious insects. Cloth bound, 268 pages, 16 full color plates, 125 other illustrations.

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919 17th Street, Northwest **Washington 6, D. C.**

Timber Rights of Life Tenants

(*Turn to page* 21)

One of the most pressing obligations of the life tenant of a timber tract is the problem of paying the taxes. The question often arises as to whether you can cut and sell some of the timber for the purpose of paying the taxes or other charges upon the property. In order to properly do this, you must be able to show that the circumstances are exceptional, but the courts in Mississippi and Ohio have sustained such a sale by the life tenant.

What are the rights of the life tenant in timber which has fallen or been blown down by a storm? The rule is that such timber belongs, at law, to the reversioner and not to the life tenant. Of course, if the trees which have been blown down are those which the tenant would have been entitled to cut, he would be entitled to their value. It has been held that the proceeds of the sale of firewood which has been blown down, assuming that nothing was used for firewood which was valuable as timber, belongs to the life tenant.

The real temptation, of course, to the life tenant is to sell off the trees for commercial purposes. In Mississippi a life tenant could not resist this temptation to sell 30,000 cypress trees growing on the property at a price of $2.50 per tree. This price, of course, would be much higher today. The sale brought the life tenant the gross sum of $75,000 but he was sued by the reversioner of the estate, the person who owns the estate after the death of the life tenant, and made to pay up. Trees, when felled or severed from the soil, become personal property, in which the law says the tenant in possession has no interest when they are cut for profit. The reversioner may accordingly maintain his action for the possession of the property or for damages therefor, in the same manner as if he were the owner and in possession of the property. The question involving this great temptation has been considered in the courts of 18 of our states, and these include such prominent states as Illinois, New York, Massachusetts, Michigan, and Texas.

Of course, this general rule has a very definite exception in the case of a life tenant of an estate which is cultivated merely for the production of salable timber and from which

the trees are cut periodically. In these situations the courts say that the case is comparable to a life tenant holding an opened mine. He may appropriate to his own use the produce of the mine and is not thus chargeable with waste or injury to the property because he does so, provided of course that he does the cutting in a proper manner. Thus, if you are the life tenant of land which the creator of your life tenancy has used for the growing of trees, you do have the right to cut the trees periodically and are entitled to the proceeds thereof. An Alabama court has said in upholding this principle of "tree farming" that protecting and cutting timber periodically and pursuing a system of reforestation is a method of cultivation, and the product from such cultivation is not a part of the inheritance but it is a part of the so-called annual fruits of the land; the timber so cultivated and cut periodically is regarded as annual profits of the estate when reforestation is carried on, and therefore it goes to the tenant for life.

In North Carolina a widow made turpentine upon land which, during the lifetime of her husband, had not been used for that purpose. The court said that she might rightfully use, in the ordinary mode of making turpentine, trees that had been boxed or intended for turpentine during the lifetime of her husband. Further it was said that she might box new trees as those already boxed for turpentine became unfit for use, but not so as to enlarge the crop beyond the extent which it had been when the dower was assigned to her.

In a Virginia case where a life tenant inherited a salt works which the owner had been accustomed to operating by using the woodlands on the property for fuel, the life tenant also had the right to thus use the woodlands. And a tenant for life of land upon which there was an open mine was permitted to use the timber on the land for the mining operation.

It should be remembered that in the case of a farm, where the timber is not the chief and natural produce for which the land is available, the rule of law regarding the rights of the life tenant to take off the trees is essentially different.

Should you wish, for any reason, to clear the land, can you cut the timber for such purpose? Again the answer to this question is affected by the fact that originally in this country, one of the major problems of those who migrated westward was the necessity for clearing at least a portion of the homestead. Certainly, historically, when you cleared land in this country you were actually improving the market value of the inheritance. The general rule now is, in the thirteen states where the matter has been considered, that you, as a tenant for life, can cut timber for the purpose of clearing the land, provided the part cleared, with that already prepared for cultivation, as compared to the remainder of the tract, does not exceed the proportion of cleared to wooded land usually maintained in good husbandry; and provided further that you do not materially lessen the value of the inheritance, that is, the value to the person who will inherit the land after your death. Certainly this is a sound and common-sense view.

Back as far as 1848 in North Carolina the court said that turning woodland into arable land, though the felled timber be sold, is not absolutely waste in our law; for cutting the timber on land fit for cultivation, or that may be made so, and reducing it to that state, may, in the condition of our country, be a benefit rather than an injury to the reversioner. Now if you do clear a portion of the land under the above rule, are you as a life tenant entitled to the timber or the proceeds thereof which you, in good faith, cut so as to fit a portion of the land for cultivation? The answer is "yes," although there are some cases which have reached a contrary conclusion.

When we come to the subject of ornamental trees (and what trees are not ornamental?) you are confronted by a unanimously strict rule against their destruction.

In summary, it is apparent that the trees may usefully serve a life tenant, but there are those that come after who have the right to enjoy their benefits.

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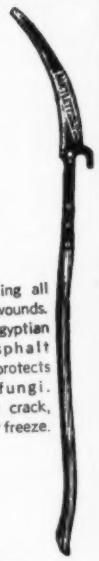

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A Half Century of Progress

(*From page 35*)

. . . The highest rate of use is in the United States, of course, but whether that means we are the most civilized may be open to some argument. At least it is a sign of abundant material prosperity." This situation is largely the result of research, which is at the threshold of still more revolutionary developments. Mr. Whitaker wonders "if our paper mills could not make much more money out of the so-called by-products of the tree than they ever did out of the paper." He predicts that "fifty years from now at another anniversary meeting, they will look back and laugh at the way we make pulp and paper today."

Almost as spectacular as developments in the pulp and paper industry have been those resulting from the development of new glues and other adhesives and increased efficiency in their use. A few comments by various speakers indicate clearly what research at the laboratory has done for such products as plywood, laminated timber, and stressed-skin panels. In forty-odd years, "plywood has advanced from a product suitable only for limited protected uses to a product that gives superb service under all use conditions."

"The beautiful modern schools, churches, and other structures radiating the warmth of wood were made possible by the work [on laminated beams and arches] done in this laboratory and by the commercial adaptation of that research."

"Ship and boat construction uses laminated wood extensively." Insulating board, of which about 5,000 tons is produced daily in the United States, mainly from wood, opened a whole new concept in the construction industry.

George E. Price, president of the National Homes Corporation, credited the Forest Products Laboratory with having made "the greatest single contribution to housing since the invention of the nail." That contribution resulted from applying to housing the principles of glued construction for airplanes developed during World War I, when it was learned that much higher strength could be obtained by gluing plywood to light wood-framing members than by simply nailing the same materials together. Employment of this principle in the design and construction of the "stressed-skin" panel provided the key for prefabricated housing. Today factory-built houses constitute about 10 per cent of the total number of houses being built and are an important part of the house-construction industry.

W. E. Difford, executive vice president of the Douglas Fir Plywood Association, made this significant statement: "Today we are developing plywood box beams in various shapes, stressed skin panels from folded plates in what we call space planes, plywood vaults, and other revolutionary building shapes. Our ability to enter a whole new era of engineering design grows out of the basic data Forest Products Laboratory developed . . . [some of which] has had a most dramatic effect upon the market place."

The role which "creative forestry" will play in providing the wood and other forest products and services needed to meet future requirements was discussed by Assistant Secretary of Agriculture Ervin L. Peterson, while Governor Gaylord Nelson described the forestry activities of the Wisconsin Department of Conservation. Forestry in its broader aspects, as well as in its relation to the production and utilization of wood, thus received a prominent place in the program, which closed with the guided tour of the laboratory.

The entire atmosphere of the Golden Anniversary celebration was one of justifiable pride in past accomplishments, of recognition that these accomplishments are but a step forward along a road to which there is no end, and of dedication to the task ahead. That task is one which must be shared with other institutions and in which full use must be made of scientific knowledge in many fields. As was pointed out by Samuel Lenher, vice president of E. I. duPont de Nemours and Company, "Science is a very stubborn genii. Despite the proliferation of disciplines and subdisciplines, science remains essentially indivisible. We may fractionate it for our own convenience, but more and more frequently we find it necessary to break through whatever partitions we erect. . . . When we consider the problems facing the industries and organizations represented at this anniversary, it is clear that we must keep the genii at its tasks in all of the institutions with a stake in the results. Only in this way can industry, government, and the academic world advance the cause of science within their own spheres, and make full use of its potential for human progress."

The history of the Forest Products Laboratory gives ample evidence that it will go forward in this spirit with increasingly valuable contributions to the well-being of the nation.

A Plea for Joshua Tree

In a plea to Rep. Clarence Cannon, chairman of the House Committee on Appropriations, Interior Secretary Fred A. Seaton on June 16 urged approval of a supplemental appropriation of $1,500,000 to help the National Park Service stave off a drive by real estate and other commercial interests to buy up 10,200 acres of inholdings in Joshua Tree National Monument in Southern California. Intense pressure of commercialization threatens this home of some rare specimens of the Joshua tree, bighorn sheep and delicate desert wildflowers, the Secretary said.

The immediate problem involves the northerly part of the monument and appears to be a speculative proposition being pushed on the basis of land exchanges. Involved, the Secretary reported, is a former employee of the Bureau of Land Management who has an interest in 18 such exchange applications. While employed by the bureau this individual actually made appraisals of these inholdings in behalf of the government, the Secretary said.

"We do not believe it is proper to permit former employees to speculate in government lands through the use of exchanges," Secretary Seaton informed Rep. Cannon.

Only answer to this pressure on the monument is immediate purchase of the 10,200 acres of inholdings, Interior representatives declared. Conservationists are rallying in urging that the Congress can take steps to put a stop to this drive by providing funds to purchase the inholdings.

"Who's Who" at the World Forestry Congress

(*From page* 8)

outstanding contributions in the field of cytology (intrinsic characteristics and functions of cells) and embryology of conifers and the genus *Ephedra*. Professor Mehra is the recipient of many academic awards including the Education Minister's Gold Medal of the National Academy of Sciences (India) for research work in botany. He is also the author of 75 publications.

A representative of Japan will be Professor Sadao Ogihara of the University of Tokyo. Professor Ogihara, who is in charge of forestry erosion control, has been teaching as well as doing research work in forestry for almost 30 years. As a result of his studies, Professor Ogihara has produced some major works, each with a summary in English, including *Erosion Control of Japan, Integral Method of Representing Stream Flow Controlling Function of Watershed and Its Application, Study on Earth Pressure at Rest,* and *A Study with the Aid of Harmonic Analysis of the Flood Controlling Function of Reservoirs.*

A member of the Second, Third, and Fourth World Forestry Congresses will come from Denmark to attend the congress in Seattle. He is Carl Syrach Larsen, director, Arboretum of the Royal Veterinary and Agricultural College at Horsholm. Dr. Larsen worked at the Danish Forest Experiment Station and Genetics Laboratory and was head of the Forest Botanic Garden before attaining his present position. A member of the Danish Academy of Technical Science, Dr. Larsen has received several awards for his work, including the Danish "Augustina" prize, and the award for Biological Research of Forestry. He is the author of several books, the most recent being *Genetics in Silviculture.*

Edward Bryan Latham will be a member of the United Kingdom delegation to the congress. Mr. Latham is chairman of James Latham Ltd., London and Nigerian Hardwood Co. Ltd., London and Nigeria. He was appointed to the U. K. Forestry Commission in 1957, and in 1959 was elected vice-chairman of the Empire Forestry Association. A Fellow of the Institute of Wood Science, which he founded in 1956, and also a Fellow of the Forest History Foundation, St. Paul, Minnesota, Mr. Latham has ably represented his country at several Commonwealth forestry conferences. He is a contributor to many publications, and is the author of *Timber: Its Development & Distribution—An Historical Survey.*

Director-General Chalerm Sirivarna, Royal Forest Department, Thailand, will represent his country at the congress. After graduating from Law School in Thailand, Mr. Sirivarna attended the Burma Forestry School, where he graduated with honors. He also studied at the International Training Center for Aerial Survey in Delft, Netherlands. Mr. Sirivarna was appointed to his present position in 1958. He is the author of *The History of Forestry in Thailand.*

West Germany's representative will be Professor Julius Speer of the University of Munich. In addition to his teaching position, Professor Speer is chairman of the forestry economics section of the International Union of Forest Research Organizations, and a member of the Valuation Advisory Council of the federal Ministry of Finance for Germany. Previously, in 1953, he was elected president of the Forestry Council of the Federal Republic of Germany which includes all forest owners' organizations and trade unions of forest workers and officers. He has also written several books on forestry.

Mr. Bertil Thunell, director of research, Swedish Forest Products Research Laboratory, is planning to attend the congress. Dr. Thunell has

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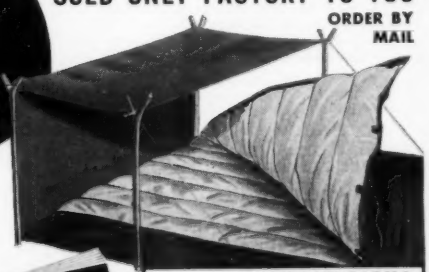
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made significant research studies on the qualities and strength properties of Swedish pine, and on woodworking machinery and sawmill equipment, especially gangsaws. He has delivered a great number of scientific papers, among which are "Wood, Its Structure and Defects," "Swedish Timbers," "Technical Productivity in Swedish Sawmilling Industry," and "Sawmilling in Sweden."

The Oak: Tree Beloved

(*From page* 31)

the office of the town clerk. In Norfolk, Virginia, Memorial Oak, a tree believed to antedate the city itself, was purchased jointly by the city and the Garden Club of Norfolk in 1923, and dedicated as a memorial to the sons of Norfolk who died in the First World War.

Charleston, South Carolina, has its Washington Live Oak. The story goes that when George Washington visited Charleston in 1791 he was a breakfast guest in the beautiful plantation home of the Pinckney family. He heard the mistress of the household order her gardener to cut down the oak tree that obstructed the view from the new portico. Washington expressed the wish that the tree should be spared. It was.

Lincoln also loved oaks. There is preserved at Hodgenville, Kentucky, his birthplace, the Lincoln Oak, which probably cast its shadow on young Abe at play.

The cities and towns named in honor of the oak comprise a long list in America: Oakland, Oakridge, Oak Park, Oakman, Forked Oak, Three Oaks, Oak Grove. It is the state tree of five states: Connecticut, Maryland, Georgia, Illinois, and New Jersey. The lovely Charter Oak, in Hartford, Connecticut, was a famous shrine in earlier days. The charter of the Connecticut colony, granted by King Charles II in 1662, was supposed to have been hidden in the oak by a patriot when Sir Edmund Andros demanded its surrender in 1687, at the command of King James II. The charter served Connecticut as a constitution from 1662 to 1816, and conveyed to the colony all land "from the said Narragansett Bay on the east to the South Sea on the west." When the tree blew down in 1856, pieces of its wood were made into gavels, picture frames, and chairs; one of the chairs stands in the senate chamber in the state capitol.

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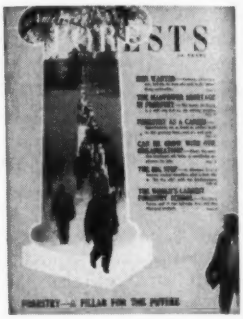

The Campaign of The American Forestry Association to encourage outstanding young men to adopt forestry as a career has resulted in the publishing of a 46-page Career reprint, containing among others the following articles from AMERICAN FORESTS Magazine:

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The oak in Tuolumne County, California, under which Mark Twain wrote the *Jumping Frog of Calaveras County*, which made him famous overnight, was known as the "Mark Twain Oak" until it was felled in 1929. Under the boughs of the Lanier Oak at Brunswick, Georgia, the southern poet Sidney Lanier was inspired to write *The Marshes of Glynn*. A favorite poem of children, written by H. F. Chorley, tells the virtues of the oak in picturesque phrases:

A song to the oak,
The brave old oak,
Who hath ruled in the greenwood long!
Here's health and renown
To his broad, green crown,
And his fifty arms so strong!

Dryden, in *Palamon and Arcite*, sings his song thus:

The monarch oak, the patriarch of the trees,
Shoots rising up, and spreads by slow degrees.
Three centuries he grows, and three he stays
Supreme in state; and in three more decays!

The Wye Oak, a mammoth white oak standing on Maryland's Eastern Shore, is said to be America's oldest and largest oak. Its exact age is not known, but arborists say it was standing as a grown tree when America was discovered. This fact influenced the state legislature to pick the oak as the state tree.

Because of its flexibility, the sapling oak was a favorite among the American Indians as a trail marker. Many of these trees, bent before white men set foot on American soil, may still be found at various places in the Mississippi Valley. A good example of a trail tree has been preserved and marked by the D. A. R. in Evanston, Illinois. Another is a white oak in Highland Park, Illinois. The latter took root at a point of secondary contact with the ground and continued to grow, with two sets of roots and several upright branches growing from the horizontal trunk.

In Westminster Abbey stands the shrine of Edward the Confessor, and the oak of which it is built is still apparently as sound as it was nearly 900 years ago. Some oaks may live 1,500 years, ranking third among trees in longevity: the giant sequoias are first, at 4,000 years, and some junipers are second, at 2,000.

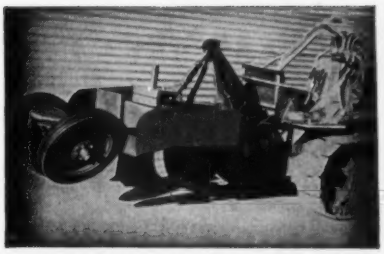
As to size, an oak in Gloucestershire has a circumference of nearly 48 feet; it has no near rival in size. The Connecticut Charter Oak, already mentioned, was so large that the hole in which the charter was concealed was enlarged enough to hold 25 men. The Emperor's Oak in Cadinen, Prussia, with a trunk 29 feet in circumference, contains a hollow chamber fitted with a locked door. It is said that 11 soldiers stood inside the tree simultaneously.

Oaks were the shelter and inspiration of the rough, tough pioneers. An ancient oak at Crockett, Texas, is said to be the tree under which Davy Crockett slept during his journey from the United States to help Texas in its struggle for freedom from Mexican rule. The Evangeline Oak at St. Martinsville, Louisiana, marks the place where the Acadians, driven from Nova Scotia, landed in 1758. It was immortalized by Longfellow's famous poem.

The leaves being so varied among the species, it is the acorn which binds the family together and distinguishes the oak from other trees. The acorn is the oak seed; it is like a round, smooth-shelled nut, pointed at its outer end and enclosed at the inner end by a saucer, or cup. Cut open a mellow acorn: inside the thin shell is the embryo of the large massive oak seen as beauty and shade along the broadest avenues, boulevards, and thoroughfares of the world's cities.

John Muir, the naturalist, found in the acorn a nourishing food to be used on his exploration trips in the California mountains. The Indians of the state ground the acorn kernels into a fine meal or flour. The bitter taste was then leached out with warm water and the meal dried and stored to be used later as a cooked mush or baked bread. And in Spain, acorns of the Gramont oak are regarded as superior to chestnuts.

The affection people have toward the oak through the centuries is epitomized in this sign at the entrance to a public park in Portugal: "Ye who would pass by and raise your hand against me, harken ere



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Bird Songs Few People Hear

(*From page* 27)

every-day notes with which he is familiar.

The kingbird is a flycatcher, and like others of his family he hunts for his flying food from a perch on fence wires, bare tree branches, or other exposed spots. On his perch, and while flying about, he utters twittering, chattering, and rasping calls. This is a common sound through spring and summer in farmlands, in city parks and vacant lots, or at the edges of town.

In the semi-darkness of pre-dawn, sometimes as early as two or three o'clock, he sings his secret song—a beautiful rolling melody, altogether different from his harsh call notes. Very rarely he sings this special song in the evening as well as in the morning.

Another flycatcher, the pewee, gives special morning and evening performances too. The pewee lives in shady groves, parks, cemeteries, and old orchards. At intervals throughout the day it sounds out its slow and lazy "Pee-a-wee, pee-wee," while it feeds.

But in the twilight or early morning, and again in the evening, the pewee puts on an uninterrupted concert which may last for half an hour or more. Instead of the pensive "human sigh"—to quote Mr. Burroughs again—the vesper and matin song is a lively twittering, interspersed with familiar "Pee-wee" notes, so you are in no doubt as to the singer's identity.

The horned lark, considered by ornithologists to be one of the most common and most widely distributed birds of this country, is a true lark. The larger, better-known meadowlark is not a lark at all, but a member of the blackbird family. Ornithologists say that if the latter bird were correctly named, it might be called "meadow starling."

The true lark is a bird of open fields, prairies, plains, and sea shores. In some places it is known as "shore lark." Instead of horns, as its name suggests, it has a pair of feathered tufts on its head.

Horned larks are year-round residents in most of this country. Except for a brief time in early spring, their usual calls are weak, twittering notes, most often likened to the creaking of fence wires.

These birds begin nesting in early spring, and it is at this time that our native lark resembles his European relative, the skylark, famous for his song. Like his famous relative, the male horned lark puts on an aerial "song and dance." Rising high up in the air, he circles and swoops among the clouds, singing as he flies. The song is a series of joyous, tinkling notes, and when it is over, the bird "parachutes" down, braking his speed just before he lands.

Little note is taken of our native lark's singing, but perhaps that is because the song is delicate and fragile, almost lost in the clouds where the singer performs, or in the din of the louder spring choruses of other birds. Those who have heard it in quiet surroundings will tell you the song is unforgettable.

Bird watchers among summer visitors to Alaska will have an opportunity to hear other songs they hadn't heard before, although they may be familiar with the singers. A number of birds which nest in the far north spend the winter in this country. Many of them do not sing their full songs except on their breeding grounds. All we are permitted to hear are their call notes.

The snow bunting's mating song has been described as a twittering warble. On their Arctic nesting grounds Lapland longspurs sing on the wing, like the skylark and the bobolink, and their loud tinkling songs have been likened to those of both of these songsters.

Even the tree sparrow, or "winter chippy," has another song besides the twittering notes we hear when the birds come to our feeders. Across Canada and Alaska, where it nests, the tree sparrow sings like a canary —a combination of high whistles and rapid warbles.

The Chestnut Challenge

(*From page* 38)

transport all of the cut hay lying out in the fields and mulched every one of the trees. The neighbors, not yet acquainted with the benefits of mulching, thought they were crazy and would cause the trees to die. But mulching helped the trees to survive a very severe winter, during which more than 60 per cent of the trees, then only 1½ feet high, were broken off or suffered broken branches. The second winter was less severe and the trees grew.

To date the blight hasn't killed any of the trees. They have suffered damage from the moles and the mice chewing on the roots, and possibly from other animals. Also it appears that frost pockets killed many, and in a few low areas where water stands without drainoff, trees have died. But according to Julie, where the chestnut trees are growing, they're "gorgeous."

So far as the native American chestnut tree is concerned, Julie has never seen one that she can recall. But she has learned from her studies that even today an occasional American chestnut shoot is found coming up, growing out of the root of a mature, dead tree or from a nut. They grow only to early bearing age and are then invariably stricken by the blight.

The combination of peach and chestnut trees worked out very well. The Horvaths had peaches within three years, and the trees grew more and more prolific while the land was standing in wait for the chestnut trees to bear.

Julie just happened to go up the hill one Fourth of July six years after they had been planted and saw the first blossoms. "They were beautiful," she says. "They amazed me." They didn't bear any nuts that year, but did the year after.

Today, 10 years later, all of the trees do not yet bear. Although some Chinese chestnut trees will blossom in six years, those are only the best ones. Others, retarded by animals or affected by weather, later pick up again and keep right on developing. Of the Horvaths' original 670 seedlings from the Leeland nuts, only 460 are now living, 180 are bearing, and the remainder are about to bear. As the trees mature, the size of the chestnuts and the yield both increase.

The Horvaths were surprised at the successful sale of nuts last year. Frank placed a $.75 ad in the Middlefield newspaper, and the people who came out to the farm were very much interested in the trees and in the Horvath's activities. They bought more than 45 pounds and elderly people, particularly, who had tasted chestnuts before, eagerly discussed them.

Says Frank, "I know that we are now in an era which will perpetuate the chestnut, and after this the United States will have chestnuts very much as we had before."

Discussing the much-improved farm, he says, "Yet there is always room for improvement. Julie says the farm is healthful, and this is very true. But it's more than that. You can work in a garden, play golf, or attend a ball game, and that's very healthful too. Here you must enjoy the open air, you must enjoy the trees, and above all you must enjoy the challenge. Then it's all worthwhile."

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Bills, Bills, Bills

(*From page* 23)

a habit of becoming old line bureaus. And as they grow and increase their spheres of service, that growth is accompanied by a legislative pattern—general organic laws tend to be amended that are spelled out in more detail by the legislative branch. Today Congress has a tendency to legislate more specifically in regard to the Forest Service than 50 years ago, and it is quite a normal thing, as history shows. As agencies of government mature, become known, and provide necessary and more widespread services, it is quite natural that the legislative branch should more specifically spell out its sphere of authority."

Dr. Crafts should know. He has been with the Forest Service for 27 years, the past nine of which he has served as assistant chief in charge of programs and legislation. Educated at Dartmouth and the University of Michigan, he received his forestry education and his Ph.D. from the latter institution. He also studied law for a year. Crafts is at all times acting chief of the Forest Service on legislative matters, and in addition has directed, in connection with his program formulation policies, such important projects as the widely-hailed "Timber Resource Review." Recent enactment of the multiple use-sustained yield law, in which he played an important role, happened to coincide with his selection by the Department of Agriculture for its "Distinguished Service Award." Of Dr. Crafts, Chief McArdle recently said, ". . . a high order of technical ability, unrelenting desire for accuracy and thoroughness, an exceptionally keen mind, unquestioned personal integrity, and intellectual honesty . . . there are times when some of us find it difficult to keep pace with such high standards, but there aren't any times when we're not glad to have someone around who has them. When you want a rug really to be looked under, you go to Ed Crafts."

Legislation as handled in the Department of Agriculture is no hit-or-miss proposition. As explained by Dr. Crafts, Secretary Benson set up a central nerve system for co-ordinating legislative activity. It goes something like this: When a Congressional committee requests the Department of Agriculture's views on a forestry measure, the Secretary's office asks the Forest Service to make a policy recommendation. This is prepared by Dr. Crafts and his assistants. Then it goes to the Secretary's top policy staff for clearance before coming back to Crafts, who next prepares a report on the bill. After this is cleared by the policy staff it goes to the Bureau of the Budget, where it is approved or modified. Occasionally conferences with the Budget Bureau or other departments are held. Then the report goes to the Hill; if the Forest Service is asked to testify, the statement made is first cleared with the Secretary's policy staff.

"This is a clear-cut system, and as a result policy is cleared at the highest level," Dr. Crafts commented. "We've had the good fortune to gain the confidence of the Secretary's office, the Budget Bureau, and the key committees with whom we work. One major factor on which this type of co-operation depends? Well, it depends on a lot of things, but the most important, I would say, is to be straightforward and always tell the truth."

Members of AFA sometimes comment on the speed with which Forest Service legislation frequently clears Congress, and we asked Dr. Crafts the reason for this.

"We often feel it takes a long time to achieve Congressional action but we play it straight with these committees on the Hill and make it a habit to level with them," Dr. Crafts said.

In the opinion of detached observers the Forest Service has remarkable success on the Hill. It maintains close liaison with its 800 offices located in 42 of the 50 states, and Forest Service people have earned the respect of the local people. Finally, the Forest Service has always had good *esprit de corps,* and it is proud of the Service and of what it stands for. So far it has had the good fortune to keep the slate clean and avoid damaging black marks. This all helps.

"My job? Basically it's legislation, policy, and program planning. As you can see, I'm on the telephone a lot, and we're always providing facts and figures for the two branches of government, particularly the members of Congress and their staffs," Dr. Crafts said. "I'm not an administrator, by the way, in the sense that Mac [Chief McArdle] is. All orders go out over his name, and all six assistant chiefs are actually advisers to the Chief. In my job, I see what the people on the outside are thinking, how they view our programs; my job, I would say, is to translate those views to our people inside.

"You've got to remember that the breadth and scope of the programs and dealings of the Forest Service are extremely broad. Some agencies have one powerful group to which they turn for help, but the Forest Service has always remained independent in that sense. We've never catered to one special interest or group, and the nature of our programs is such that we have to work with them all. Yes, it's difficult, but because we do deal with such a variety of interests it tends to keep a cross-check on us and to create balance and understanding. Actually, we are inclined to get just a little uneasy if we find one special group making too much of a fuss over us—start wondering if we've gone overboard somewhere. The conservation groups? They are of tremendous help to us as long as they do not become special pleaders, and here again I hope we've gained their mutual respect.

"Small woodlands? Competition for land and national parks-national forest relationships? I wish I knew the answers. I do feel that Mac [Chief McArdle] has been making people do some good hard thinking on these subjects as the result of some of his recent talks. The speech he made at the paper meeting was one of the best he ever made, some of us think."

With forestry now beginning to spell out and apply its multiple use concepts to public and private land, it goes without saying that the national forests should be in the front rank of this effort and that legislative liaison must be of the highest order. In Dr. Crafts and his staff, the public has a dedicated group of representatives, but as they fully realize, it isn't going to be any snap. "It's easy enough to practice multiple use when there is no shortage of resources," Crafts comments. "We are entering an era of increasing demand and competition for land resources. But our land base is fixed. The effective practice of multiple use under these conditions will truly test our skills as foresters and resource managers. When the pinch comes, tremendous pressures will be generated. This is already starting, and it will separate the men from the boys."

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